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DEAN'S SYSTEM
# of Greenhouse Heating

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DEAN'S SYSTEM OF GREENHOUSE HEATING

BY STEAM OR HOT WATER

WITH

FORMULAS FOR OBTAINING DIFFERENT
TEMPERATURES

TABLES GIVING RADIATION NECESSARY PER SQUARE FOOT OF GLASS.
TABLES GIVING GLASS SURFACE, SIZES OF FLOW AND
RETURN PIPES, LIST PRICES OF PIPE AND
FITTINGS, AND OTHER USEFUL
INFORMATION

14/9375

BY

MARK DEAN

AUTHOR AND PUBLISHER OF
"THE STEAM-FITTERS' COMPUTATION AND PRICE BOOK."

PUBLISHED BY MARK DEAN, BOSTON, MASS.

PRICE, TWO DOLLARS

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PREFACE.

HAVING been urged by some of my friends to put into book form, for commercial use, the formulas and tables used by me in greenhouse heating, I decided to accept the suggestion and give herein such data as I think will be most useful to any who are required to do greenhouse heating.

Like all books of its class, the user will find it more and more convenient as he becomes better acquainted with its contents.

It has been the author's desire to limit the tables to such as would cover all ordinary cases and thereby keep the book of convenient size and the price within reach of all.

I have endeavored to make explanations to tables so simple that all might understand, and yet, I hope they will not prove tiresome to those well versed in the business.

MARK DEAN.

PERHAPS no other class of buildings require more even temperature than greenhouses because the life of plants and success of the hothouse business depend upon constant heat, and as plant life can only be developed to the limit of its vitality and beauty when in a temperature best adapted to its growth, the subject of heating becomes one of great importance and should, therefore, receive mature consideration.

Steam or hot water are generally conceded to be the only systems of practical value for any except small houses,—and are best for them. The relative value of steam and hot water depends materially upon the individual requirements of each case; however, steam is generally acknowledged to be superior for large greenhouses because of its adaptability to sudden changes in temperature, thus off-setting any rise or fall of the outside thermometer. Then too, if properly handled, it should be most economical on account of the peculiar requirements.

Even in severe weather, greenhouses need but little or no heat while the sun's rays strike the glass, but must have it quickly as the heat from the sun is being withdrawn. It is self evident that one barrel of water can be heated more quickly, with less fuel, and sent through the pipes faster in the form of steam than can ten barrels of water with only the force of gravity to send it along. When heated, the ten barrels of water will remain hot much longer than one, thus the water becomes a sort of storage for heat which, however, is objectionable because in the morning, when the sun looks upon the glass, there is immediately too much heat, to relieve which, the ventilators are opened and the stored heat is wasted. In other words, the fuel required to heat the extra nine barrels of water is generally thrown away next morning.*

For many reasons such as shallow boiler-pit, lack of night fireman, etc., the points in favor of hot water more than off-set the objections already named, and the only way to determine which is best is to consider all requirements and conditions of each individual case.

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*This of course does not apply to ordinary buildings, on the contrary, the storage of heat in the hot water is very advantageous.

To greenhouse owners who are building and are not equipped with drafting board and tools I suggest, as a saving in the end, to employ some competent heating engineer to prepare a set of working drawings. You might as well expect roses from thistles, as good results from a poor boiler and insufficient piping improperly installed.

I have advised engaging a competent engineer to lay out the work, not only to save labor of installing, but also as a saving of fuel. For instance, what I have said about steam v.s. hot water is equally true, though in a less degree, of hot water in large pipes v.s. hot water in small pipes. One four inch pipe holds double the amount of water and only has the same radiating capacity as two two inch pipes. That is, if it required ten barrels of water with four inch pipes, it would only require five barrels of water to maintain the same degree of heat in the same house with two inch pipes. The smaller the pipe the less water it holds per square foot of radiation, therefore use the smallest pipe possible consistent with its length i.e., with the amount of radiation attached to it. The water in the pipes is being constantly cooled as it moves along. To get the best results its temperature must not be allowed to get too low, therefore, there is a limit of length for each size pipe and a pipe too small is as bad, or worse, than a pipe too large. On page 33 is a table giving limit of length for different size pipes.

It is not always wise, or even generally so, to copy from another plant simply because the owner is satisfied with its operation. He may be more easily satisfied than you would, or it may be that he gets sufficient heat, but on account of pipes too large, pipes too small, or circulation choked (see table page 31 for equalization of carrying capacities of pipes) his plant is not as economical as it should be. The best are none too economical and it seems the height of folly to save a few dollars on first cost (that is where the trouble often originates) and thereby form a source of continual waste.

DEAN'S SYSTEM OF ESTIMATING STEAM AND HOT-WATER HEATING FOR GREENHOUSES.

THE system and formulas given under this heading are some which the author has used for years and knows to be convenient and reliable. A few moments' study will enable, even the inexperienced, to use them to advantage, and when once familiar with them, estimating greenhouse heating becomes very simple.

The entire system is based on greenhouses of various widths one foot long. If the radiation is sufficient to maintain the required temperature in a house one foot long, the same amount applied in the same manner will heat the next foot, and so on to the end of the house where the pipes are turned across to both heat the end and allow for expansion.

HOW TO USE TABLES ON PAGES 10 AND 11.

To find the sq. ft. of radiation per lineal foot of house look opposite number of feet of "glass equivalent over roof," as given in the tables, and under the desired temperature will be the amount.

For total number of square feet of radiation multiply the number of square feet required per foot of house by the length of the house, plus one-fourth the width of its exposed ends.

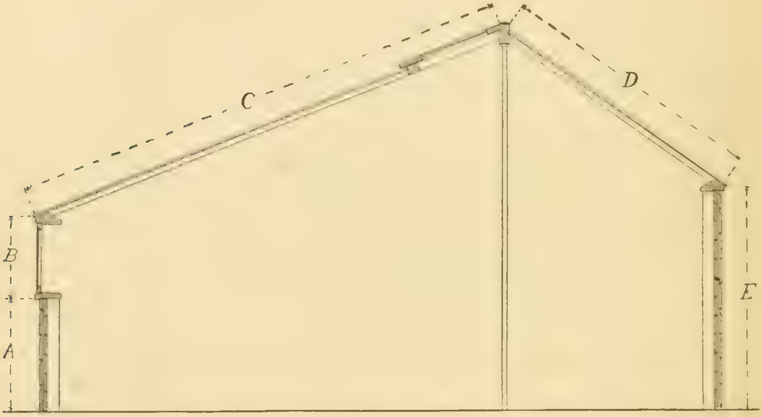
To enable the reader to more easily grasp my ideas I here illustrate the following:—

EXAMPLE:

How many pipes, and of what sizes, would be required to heat by steam in zero weather to 55° Fht. a greenhouse 18 x 90 ft. boarded 3 ft. high on front wall, plus 2 ft. 3 ins. of glass, rear wall six ft. high without glass, front sash bars 13 ft. 3 ins. long, rear sash bars 7 ft. long? See cut on next page.

First obtain the distance in glass, or its equivalent, from ground over roof to ground on opposite side.

To reduce ordinary walls, boarded with paper between, to glass surface, divide the number of square ft. by 3. If there is another lining of boards on inside of posts, thus forming an air space, divide by 7. If double boarded and papered both inside and outside, with air space between, divide by 10.



Reduce wall surface to glass by dividing same by three.

Wall Surface { A=3 ft.
E=6 ft.
——
9 ft. ÷ 3 to reduce to its equivalent in glass surface = 3 ft.

Glass Equivalent over Roof	Wall surface equals	3 ft.		Glass exposure		
	B	"	2 ft.	3 in.	"	"
	C	"	13 ft.	3 in.	"	"
	D	"	7 ft.		"	"
	Total glass equivalent over roof		25 ft.	6 in.		

When glass equivalent is fraction of a foot less than one-half, use the next larger "width over roof."

ON page 10 opposite 25½ and under 55° we find 4.08, the amount of radiation necessary per lineal foot of house, which multiplied by the length of the house, plus one-fourth its width (90 plus 5 = 95,) equals 387 sq. ft.*

Under ordinary circumstances it is unnecessary to devote special attention to the ends, simply continue the side pipes across the exposed ends.

As the steam main is one of the heating pipes in the greenhouse the amount of radiation in it per foot must be subtracted from the total amount required per foot, 4.08 minus .75 equals 3.33.† We now have 3.33 sq. ft. per ft. of house to be distributed in the heating pipes. By reference to diagram on page 32 it will be observed that it requires either eight 1¼″ pipes, or seven 1½″ pipes, and as the house is short the 1¼ inch pipes are preferable.

If two 2″ flow pipes should prove preferable to one 2½″ pipe proceed in the same manner. (Reference to table page 12 shows that two 2″ pipes would have 1.24 sq. ft. of radiation per lineal ft.) 4.08 minus 1.24 equals 2.84, the amount to be distributed in the heating pipes. Referring again to diagram, page 32, you will see that it requires seven 1¼ or six 1½″ pipes. Proceed in the same manner for all houses of ordinary dimensions; for houses of special dimensions see page 15.

*On page 31 you will find that it requires a 2½" pipe to supply this amount of steam radiation.

†For sq. ft. of radiation per lineal ft. of pipe see table page 12.

STEAM.

RADIATION PER LINEAL FT. OF HOUSE.

Opposite "Glass equivalent over roof" and under the desired temperature will be found the square feet of radiation necessary to heat the house in zero weather to that temperature. To obtain the total radiation for a house multiply the number thus found by the length of the house, plus one-fourth the width of the exposed ends. When exact width over roof is not given, use next larger. These tables are based on weather from zero to 15° below. For temperatures above zero deduct 2 per cent for each degree. For temperatures lower than 15° below zero add 2 per cent for each degree.

Glass Equivalent over Roof	TEMPERATURE DESIRED						
	40°	45°	50°	55°	60°	65°	70°
6	.72	.8	.9	.96	1.02	1.11	1.2
6½	.78	.87	.98	1.04	1.11	1.2	1.3
7	.84	.94	1.05	1.14	1.21	1.3	1.4
7½	.90	1.	1.13	1.22	1.28	1.39	1.5
8	.96	1.06	1.21	1.28	1.38	1.48	1.6
8½	1.02	1.13	1.28	1.36	1.46	1.57	1.7
9	1.08	1.2	1.35	1.44	1.54	1.66	1.8
9½	1.14	1.26	1.43	1.52	1.63	1.76	1.9
10	1.2	1.33	1.52	1.6	1.72	1.85	2.
10½	1.26	1.4	1.58	1.68	1.81	1.95	2.1
11	1.32	1.46	1.67	1.76	1.88	2.04	2.2
11½	1.38	1.54	1.73	1.84	1.98	2.13	2.3
12	1.44	1.6	1.82	1.92	2.07	2.22	2.4
12½	1.51	1.67	1.88	2.	2.14	2.31	2.5
13	1.56	1.73	1.97	2.08	2.24	2.41	2.6
13½	1.62	1.8	2.05	2.16	2.33	2.5	2.7
14	1.68	1.87	2.12	2.24	2.41	2.59	2.8
14½	1.74	1.93	2.20	2.32	2.5	2.68	2.9
15	1.81	2.	2.26	2.4	2.58	2.78	3.
15½	1.86	2.07	2.35	2.48	2.67	2.87	3.1
16	1.92	2.14	2.42	2.56	2.76	2.96	3.2
16½	1.98	2.2	2.50	2.64	2.84	3.05	3.3
17	2.04	2.27	2.58	2.72	2.93	3.15	3.4
17½	2.11	2.33	2.65	2.8	3.02	3.24	3.5
18	2.16	2.4	2.72	2.88	3.1	3.33	3.6
18½	2.22	2.47	2.8	2.96	3.19	3.43	3.7
19	2.28	2.54	2.88	3.04	3.28	3.52	3.8
19½	2.34	2.6	2.98	3.12	3.36	3.61	3.9
20	2.41	2.67	3.03	3.2	3.40	3.71	4.
20½	2.46	2.73	3.11	3.28	3.53	3.8	4.1
21	2.52	2.8	3.18	3.36	3.62	3.89	4.2
21½	2.58	2.87	3.26	3.44	3.7	3.98	4.3
22	2.64	2.93	3.33	3.52	3.79	4.07	4.4
22½	2.71	3.	3.41	3.6	3.88	4.16	4.5
23	2.76	3.07	3.49	3.68	3.96	4.26	4.6
23½	2.82	3.13	3.56	3.76	4.05	4.35	4.7
24	2.88	3.2	3.64	3.84	4.14	4.45	4.8
24½	2.94	3.27	3.71	3.92	4.22	4.54	4.9
25	3.01	3.34	3.79	4.	4.31	4.63	5.
25½	3.06	3.41	3.86	4.08	4.4	4.72	5.1
26	3.14	3.47	3.94	4.16	4.48	4.81	5.2
26½	3.18	3.54	4.01	4.24	4.57	4.91	5.3
27	3.24	3.6	4.08	4.32	4.65	5.	5.4
27½	3.31	3.66	4.17	4.41	4.74	5.1	5.5
28	3.36	3.74	4.24	4.48	4.83	5.19	5.6
28½	3.42	3.8	4.32	4.56	4.87	5.28	5.7
29	3.48	3.86	4.36	4.64	4.95	5.37	5.8
29½	3.57	3.93	4.46	4.72	5.03	5.46	5.9
30	3.61	4.	4.54	4.8	5.12	5.55	6.
30½	3.66	4.06	4.62	4.88	5.21	5.65	6.1
31	3.73	4.13	4.66	4.96	5.3	5.74	6.2
31½	3.78	4.2	4.74	5.04	5.39	5.84	6.3
32	3.84	4.26	4.82	5.12	5.48	5.93	6.4
32½	3.90	4.34	4.88	5.2	5.57	6.02	6.5
33	3.96	4.4	4.96	5.28	5.65	6.11	6.6
33½	4.02	4.47	5.04	5.36	5.74	6.2	6.7
34	4.08	4.54	5.12	5 44	5.83	6.3	6.8
34½	4.14	4.6	5.19	5 52	5.9	6.4	6.9
35	4.2	4 66	5.26	5.6	5.98	6.49	7.
35½	4.26	4.74	5.34	5 68	6.06	6.58	7.1
36	4.32	4 8	5.42	5.76	6.14	6.67	7.2
36½	4.38	4.86	5.5	5 84	6 24	6.76	7.3
37	4 44	4.93	5.56	5.92	6.32	6.85	7 4
37½	4.5	5.	5.64	6.	6.42	6.94	7.5
38	4.56	5.07	5.72	6 08	6 5	7.04	7.6
38½	4.62	5.14	5.79	6 16	6.58	7.13	7.7
39	4.68	5.21	5.86	6.24	6.66	7.22	7.8
39½	4.74	5.28	5.94	6 32	6.74	7.31	7.9
40	4.8	5.35	6.02	6.4	6.83	7.4	8.
40½	4.86	5.41	6.1	6.48	6 92	7.49	8.1
41	4.92	5.48	6.17	6 56	7.	7.58	8.2
41½	4 98	5.54	6.24	6 64	7.1	7.67	8.3
42	5.04	5.6	6.32	6.72	7.19	7.76	8.4
42½	5.1	5.67	6.4	6.8	7 28	7.85	8.5
43	5.16	5.74	6.47	6.88	7.37	7.95	8.6
43½	5.22	5.81	6.54	6 96	7.46	8.05	8.7
44	5.28	5.87	6.61	7.04	7.55	8 15	8.8
44½	5.34	5.94	6.69	7 12	7.64	8.24	8.9
45	5.4	6.	6.76	7.2	7.72	8.33	9.
45½	5 46	6.06	6 84	7.28	7.8	8.42	9.1
46	5.52	6.12	6.92	7.36	7.88	8.51	9.2
46½	5.58	6 2	7.	7.44	7.96	8.6	9.3
47	5.64	6.26	7.07	7.52	8 05	8 69	9.4
47½	5.7	6.33	7.14	7.6	8 12	8.78	9.5
48	5.76	6.4	7.21	7 68	8.2	8 87	9.6
48½	5.82	6 47	7.28	7.76	8 28	8.96	9.7
49	5.88	6.54	7.36	7 84	8 36	9 06	9.8
49½	5.94	6.6	7.43	7.92	8 46	9.15	9.9
50	6.	6.66	7.5	8.	8.55	9.25	10.
50½	6.08	6.73	7.57	8 07	8.7	9.33	10
51	6 12	6.80	7.66	8 16	8.8	9 45	10.2
51½	6.19	6.87	7.73	8 24	8 88	9.54	10.3
52	6.25	6.93	7.80	8 32	8 97	9 63	10 4
52½	6.30	7.	7.88	8 40	9.05	9.72	10.5
53	6.36	7.07	7.96	8.48	9 13	9.81	10.6
53½	6.43	7 14	8.04	8.56	9 23	9.91	10.7
54	6.48	7 20	8.11	8.64	9.31	10.	10.8
54½	6.54	7.27	8.18	8.70	9.40	10 09	10.9
55	6.60	7.34	8.26	8.78	9 49	10.18	11.
55½	6.67	7.40	8.34	8 86	9.57	10.27	11.1
56	6.73	7.47	8.41	8.94	9.66	10 36	11.2
56½	6 79	7.54	8.48	9.04	9.75	10 46	11 3
57	6.85	7.60	8.55	9.12	9 83	10.55	11 4
57½	6.91	7.67	8.64	9.20	9.92	10.65	11.5
58	6.97	7.74	8.71	9.28	10	10.74	11.6
58½	7.03	7.80	8.78	9 36	10 08	10.83	11.7
59	7.08	7.87	8.86	9.44	10 17	10.92	11.8
59½	7.15	7.94	8 94	9 52	10 26	11 01	11.9

NOTE:—If house is 60 ft. wide or over use half the width and double the amount.

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HOT WATER.

RADIATION PER LINEAL FT. OF HOUSE.

Opposite "Glass equivalent over roof" and under the desired temperature will be found the square feet of radiation necessary in zero weather to heat the house to that temperature. To obtain the total radiation for a house multiply the number thus found by the length of the house, plus one-fourth the width of the exposed ends. When exact width over roof is not given, use next larger. These tables are based on weather from zero to 15° below. For temperatures above zero deduct 2 per cent for each degree. For temperatures lower than 15° below zero add 2 per cent for each degree.

Glass Equivalent over Roof	TEMPERATURE DESIRED						
	40°	45°	50°	55°	60°	65°	70°
6	1.2	1.34	1.5	1.6	1.72	1.85	2.
6½	1.3	1.45	1.63	1.74	1.86	2.	2.17
7	1.4	1.56	1.75	1.87	2.	2.16	2.33
7½	1.5	1.67	1.88	2.	2.14	2.32	2.5
8	1.6	1.78	2.	2.13	2.28	2.48	2.67
8½	1.7	1.89	2.13	2.26	2.43	2.63	2.83
9	1.8	2.	2.25	2.4	2.57	2.79	3.
9½	1.9	2.11	2.38	2.53	2.72	2.92	3.17
10	2.	2.22	2.5	2.66	2.86	3.08	3.34
10½	2.1	2.33	2.63	2.8	3.	3.24	3.5
11	2.2	2.44	3.75	2.93	3.15	3.39	3.67
11½	2.3	2.55	2.88	3.06	3.29	3.54	3.84
12	2.4	2.66	3.	3.2	3.43	3.7	4.
12½	2.5	2.78	3.13	3.33	3.58	3.85	4.17
13	2.6	2.89	3.25	3.46	3.72	4.	4.34
13½	2.7	3.	3.38	3.6	3.86	4.16	4.5
14	2.8	3.11	3.5	3.73	4.	4.32	4.67
14½	2.9	3.22	3.63	3.87	4.15	4.47	4.48
15	3.	3.33	3.75	4.	4.29	4.63	5.
15½	3.1	3.44	3.88	4.13	4.43	4.77	5.17
16	3.2	3.55	4.	4.26	4.57	4.92	5.34
16½	3.3	3.66	4.13	4.4	4.72	5.08	5.5
17	3.4	3.78	4.25	4.53	4.86	5.24	5.67
17½	3.5	3.89	4.38	4.67	5.	5.39	5.84
18	3.6	4.	4.5	4.8	5.15	5.54	6.
18½	3.7	4.11	4.63	4.93	5.29	5.7	6.17
19	3.8	4.22	4.75	5.06	5.43	5.85	6.34
19½	3.9	4.33	4.88	5.2	5.58	6.	6.5
20	4.	4.44	5.	5.33	5.72	6.16	6.67
20½	4.1	4.55	5.13	5.46	5.86	6.32	6.84
21	4.2	4.66	5.25	5.6	6.	6.47	7.
21½	4.3	4.78	5.38	5.74	6.15	6.63	7.17
22	4.4	4.89	5.5	5.88	6.29	6.77	7.34
22½	4.5	5.	5.62	6.	6.43	6.92	7.5
23	4.6	5.11	5.75	6.13	6.57	7.08	7.67
23½	4.7	5.22	5.88	6.26	6.72	7.24	7.84
24	4.8	5.33	6.	6.4	6.86	7.39	8.
24½	4.9	5.44	6.13	6.53	7.	7.54	8.17
25	5.	5.55	6.25	6.66	7.15	7.7	8.34
25½	5.1	5.66	6.38	6.8	7.29	7.85	8.5
26	5.2	5.78	6.5	6.93	7.43	8.	8.67
26½	5.3	5.89	6.63	7.07	7.57	8.16	8.84
27	5.4	6.	6.75	7.2	7.72	8.32	9.
27½	5.5	6.11	6.88	7.34	7.86	8.47	9.17
28	5.6	6.22	7.	7.47	8.	8.63	9.34
28½	5.7	6.33	7.13	7.6	8.15	8.77	9.5
29	5.8	6.44	7.25	7.73	8.29	8.92	9.66
29½	5.9	6.55	7.38	7.88	8.43	9.08	9.84
30	6.	6.66	7.5	8.	8.57	9.24	10.
30½	6.1	6.78	7.63	8.13	8.72	9.39	10.17
31	6.2	6.89	7.75	8.26	8.86	9.54	10.34
31½	6.3	7.	7.88	8.4	9.	9.7	10.5
32	6.4	7.11	8.	8.53	9.15	9.85	10.67
32½	6.5	7.22	8.13	8.66	9.29	10.	10.83
33	6.6	7.33	8.25	8.8	9.43	10.16	11.
33½	6.7	7.44	8.38	8.93	9.57	10.32	11.17
34	6.8	7.55	8.5	9.06	9.72	10.47	11.34
34½	6.9	7.66	8.63	9.2	9.86	10.63	11.5
35	7.	7.78	8.75	9.33	10.	10.77	11.67
35½	7.1	7.89	8.88	9.46	10.15	10.92	11.84
36	7.2	8.	9.	9.6	10.29	11.08	12.
36½	7.3	8.11	9.13	9.73	10.42	11.24	12.17
37	7.4	8.22	9.25	9.88	10.57	11.39	12.34
37½	7.5	8.33	9.38	10.	10.72	11.54	12.5
38	7.6	8.44	9.5	10.13	10.86	11.7	12.67
38½	7.7	8.55	9.62	10.26	11.	11.85	12.84
39	7.8	8.66	9.75	10.4	11.15	12.	13.
39½	7.9	8.78	9.88	10.53	11.29	12.16	13.17
40	8.	8.89	10.	10.66	11.43	12.32	13.34
40½	8.1	9.	10.13	10.8	11.57	12.48	13.5
41	8.2	9.11	10.25	10.93	11.72	12.63	13.67
41½	8.3	9.22	10.38	11.06	11.86	12.77	13.83
42	8.4	9.33	10.5	11.2	12.	12.92	14.
42½	8.5	9.44	10.63	11.33	12.15	13.08	14.17
43	8.6	9.55	10.75	11.46	12.29	13.24	14.34
43½	8.7	9.66	10.88	11.6	12.42	13.39	14.5
44	8.8	9.78	11.	11.73	12.57	13.54	14.67
44½	8.9	9.89	11.13	11.88	12.72	13.7	14.83
45	9.	10.	11.25	12.	12.86	13.85	15.
45½	9.1	10.11	11.38	12.13	13.	14.	15.17
46	9.2	10.22	11.5	12.26	13.15	14.16	15.34
46½	9.3	10.33	11.62	12.4	13.29	14.32	15.5
47	9.4	10.44	11.75	12.53	13.43	14.47	15.67
47½	9.5	10.55	11.88	12.66	13.57	14.63	15.83
48	9.6	10.66	12.	12.8	13.72	14.77	16.
48½	9.7	10.78	12.13	12.93	13.86	14.92	16.17
49	9.8	10.89	12.25	13.06	14.	15.08	16.34
49½	9.9	11.	12.38	13.2	14.15	15.24	16.5
50	10.	11.11	12.5	13.33	14.29	15.39	16.67
50½	10.1	11.22	12.62	13.46	14.43	15.54	16.84
51	10.2	11.33	12.75	13.6	14.57	15.7	17.
51½	10.3	11.44	12.88	13.73	14.72	15.85	17.17
52	10.4	11.55	13.	13.88	14.86	16.	17.32
52½	10.5	11.66	13.13	14.	15.	16.16	17.5
53	10.6	11.78	13.25	14.13	15.15	16.32	17.67
53½	10.7	11.89	13.38	14.26	15.29	16.47	17.84
54	10.8	12.	13.5	14.4	15.43	16.62	18.
54½	10.9	12.12	14.52	14.52	15.57	16.76	18.16
55	11.	12.23	14.66	14.66	15.72	16.93	18.33
55½	11.1	12.34	14.8	14.8	15.86	17.09	18.5
56	11.2	12.45	14.93	14.93	16.	17.23	18.67
56½	11.3	12.56	15.06	15.06	16.15	17.4	18.83
57	11.4	12.67	15.20	15.2	16.29	17.55	19.
57½	11.5	12.78	15.33	15.33	16.44	17.7	19.16
58	11.6	12.89	15.46	15.46	16.57	17.85	19.33
58½	11.7	3.	15.6	15.6	16.72	18.	19.5
59	11.8	3.11	15.73	15.73	16.86	18.15	19.67
59½	11.9	3.22	15.86	15.86	7.	18.3	19.83

NOTE:—If house is 60 ft. or over use half the width and double the amount.

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RADIATING SURFACE OF PIPES.

To ascertain the number of square feet of radiation in any given number of lineal feet of pipe, look under size of pipe as given at top of page and opposite length of pipe given on left hand side of page: the number found will be the number of square feet of radiation in the pipe. On all lengths over one foot, fractions less than tenths are added to or dropped and all fractions less than one are added to or dropped on lengths over 61 feet.

Length of Pipe	SIZE OF PIPE.																	
	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	11	12
1	.275	.346	.434	.494	.622	.753	.916	1.055	1.175	1.309	1.455	1.739	1.996	2.257	2.519	2.816	3.14	3.341
2	.5	.7	.9	1.	1.2	1.5	1.8	2.1	2.5	2.6	2.9	3.5	4.	4.5	5.	5.6	6.3	6.7
3	.8	1.	1.3	1.5	1.9	2.3	2.7	3.2	3.5	3.9	4.4	5.2	6.	6.8	7.6	8.5	9.4	10.
4	1.1	1.4	1.7	2.	2.5	3.	3.6	4.2	4.7	5.2	5.8	7.	8.	9.	10.	11.2	12.6	13.4
5	1.4	1.7	2.2	2.4	3.1	3.8	4.6	5.3	5.8	6.5	7.3	8.7	10.	11.3	12.6	14.1	15.7	16.7
6	1.6	2.1	2.6	2.9	3.7	4.5	5.5	6.3	7.	7.8	8.7	10.5	12.	13.5	15.1	16.9	18.8	20.
7	1.9	2.4	3.	3.4	4.4	5.3	6.4	7.4	8.2	9.1	10.2	12.1	14.	15.8	17.6	19.7	22.	23.4
8	2.2	2.8	3.5	3.9	5.	6.	7.3	8.4	9.4	10.4	11.6	13.9	16.	18.	20.2	22.5	25.1	26.7
9	2.5	3.1	3.9	4.4	5.6	6.8	8.2	9.5	10.6	11.7	13.1	15.7	18.	20.3	22.6	25.3	28.3	30.1
10	2.7	3.5	4.3	4.9	6.2	7.5	9.1	10.5	11.8	13.1	14.6	17.4	20.	22.6	25.2	28.2	31.4	33.4
11	3.	3.8	4.8	5.4	6.8	8.3	10.	11.6	13.	14.4	16.	19.1	22.	24.9	27.7	31.	34.5	36.8
12	3.3	4.1	5.2	5.9	7.5	9.	11.	12.6	14.1	15.7	17.4	20.9	24.	27.1	30.2	33.8	37.7	40.1
13	3.6	4.5	5.6	6.4	8.1	9.8	11.9	13.7	15.3	17.	18.9	22.6	26.	29.4	32.8	36.6	40.8	43.5
14	3.8	4.8	6.1	6.9	8.7	10.5	12.8	14.7	16.5	18.3	20.3	24.3	28.	31.6	35.3	39.4	44.	46.9
15	4.1	5.2	6.5	7.4	9.3	11.3	13.7	15.8	17.6	19.6	21.8	26.1	30.	33.9	37.7	42.2	47.1	50.1
16	4.4	5.5	6.9	7.9	10.	12.	14.6	16.9	18.8	20.9	23.2	27.8	32.	36.1	40.3	45.	50.2	53.5
17	4.7	5.9	7.4	8.4	10.6	12.8	15.5	17.9	20.	22.2	24.8	29.5	34.	38.4	42.8	47.9	53.4	57.
18	5.	6.2	7.8	8.9	11.2	13.5	16.5	19.	21.2	23.5	26.2	31.3	36.	40.6	45.4	50.8	56.5	60.2
19	5.2	6.6	8.3	9.4	11.8	14.3	17.4	20.	22.3	24.9	27.6	33.1	38.	42.9	47.9	53.5	59.7	63.6
20	5.5	6.9	8.7	9.9	12.5	15.	18.3	21.1	23.5	26.1	29.1	34.8	40.	45.2	50.2	56.4	62.8	67.
21	5.8	7.3	9.1	10.4	13.	15.8	19.2	22.1	24.7	27.5	30.5	36.5	42.	47.4	52.8	59.1	66.	70.2
22	6.	7.6	9.6	10.9	13.7	16.5	20.2	23.2	25.9	28.8	32.	38.3	44.	49.7	55.4	62.	69.1	73.5
23	6.3	8.	10.	11.3	14.3	17.3	21.1	24.3	27.	30.1	33.5	40.	46.	52.	58.	64.9	72.3	77.
24	6.6	8.3	10.4	11.9	14.9	18.	22.	25.3	28.2	31.4	34.9	41.7	48.	54.2	60.4	67.6	75.4	80.3
25	6.9	8.6	10.9	12.3	15.6	18.8	22.9	26.3	29.3	32.7	36.3	43.5	50.	56.4	63.	70.4	78.5	83.6
26	7.2	9.	11.3	12.8	16.2	19.5	23.8	27.4	30.5	34.	37.8	45.2	52.	58.6	65.4	73.2	81.6	87.
27	7.4	9.4	11.7	13.3	16.8	20.3	24.7	28.5	31.7	35.3	39.3	47.	54.	61.	68.	76.	84.8	90.3
28	7.7	9.7	12.2	13.8	17.4	21	25.6	29.5	32.9	36.6	40.7	48.7	56.	63.2	70.5	78.8	87.9	93.6
29	8.	10.	12.6	14.3	18.	21.8	26.6	30.6	34.1	37.9	42.2	50.4	58.	65.5	73.	81.8	91.	97.
30	8.3	10.4	13.	14.8	18.7	22.5	27.5	31.6	35.3	39.2	43.6	52.1	60.	67.8	75.5	84.4	94.2	100.4
31	8.5	10.7	13.5	15.3	19.3	23.3	28.4	32.7	36.4	40.5	45.1	53.9	62.	70.	78.	87.2	97.4	103.7
32	8.8	11.1	13.9	15.8	19.9	24.1	29.3	33.7	37.6	41.8	46.5	55.6	64.	74.	80.6	90.	100.5	107.
33	9.1	11.4	14.3	16.3	20.5	24.8	30.2	34.8	38.8	43.2	48.	57.4	66.	74.4	83.1	93.	103.6	110.3
34	9.4	11.7	14.7	16.8	21.2	25.6	31.1	35.8	40.	44.5	49.5	59.1	68.	76.7	85.6	95.8	106.8	113.6
35	9.6	12.1	15.2	17.3	21.8	26.3	32.	36.9	41.1	45.8	50.9	60.8	70.	79.	88.1	98.5	110.	117.
36	9.9	12.5	15.6	17.8	22.4	27.	33.	38.	42.3	47.1	52.4	62.6	72.	81.3	90.7	101.3	113.	120.3
37	10.2	12.8	16.1	18.3	23.	27.8	33.9	39.	43.5	48.4	53.8	64.3	74.	83.6	93.2	104.2	116.2	123.7
38	10.5	13.2	16.5	18.8	23.7	28.5	34.8	40.1	44.6	49.7	55.2	66.	76.	85.9	95.7	107.	119.3	127.2
39	10.7	13.5	16.9	19.3	24.3	29.3	35.7	41.1	45.8	51.1	56.8	67.8	78.	88.	98.3	109.8	122.5	130.5
40	11.	13.8	17.4	19.8	24.9	30.1	36.6	42.2	47.	52.3	58.2	69.5	80.	90.2	100.7	112.6	125.6	133.8
41	11.3	14.2	17.8	20.5	25.5	30.8	37.6	43.2	48.2	53.6	59.6	71.3	82.	92.5	103.3	115.5	128.8	137.2
42	11.6	14.5	18.2	20.8	26.1	31.6	38.5	44.3	49.4	55.	61.1	73.	84.	94.9	105.8	118.3	131.9	140.5
43	11.8	14.9	18.7	21.3	26.8	32.3	39.4	45.3	50.6	56.3	62.5	74.8	86.	97.	108.2	121.	135.	143.8
44	12.1	15.2	19.1	21.8	27.4	33.1	40.3	46.4	51.7	57.6	64.	76.5	88.	99.5	110.8	124.	138.2	147.2
45	12.4	15.6	19.5	22.4	28.	33.8	41.2	47.4	52.9	58.9	65.5	78.2	90.	101.6	113.3	126.7	141.3	150.5
46	12.7	15.9	20.	22.7	28.6	34.6	42.2	48.5	54.	60.2	67.	80.	92.	103.8	115.8	129.5	144.3	154.
47	12.9	16.3	20.4	23.2	29.2	35.3	43.	49.6	55.2	61.5	68.4	81.7	94.	106.	118.3	132.3	147.5	157.2
48	13.2	16.6	20.8	23.7	29.9	36.1	43.9	50.6	56.4	62.8	69.9	83.5	96.	108.4	120.9	135.2	150.7	160.6
49	13.5	17.	21.3	24.2	30.5	36.8	44.8	51.7	57.6	64.1	71.2	85.1	98.	110.5	123.4	138.	153.9	164.
50	13.8	17.3	21.7	24.7	31.1	37.6	45.8	52.8	58.7	65.4	72.8	87.	100.	112.8	126.	140.8	157.	167.2
51	14.	17.6	22.1	25.2	31.7	38.3	46.7	53.8	60.	66.8	74.2	88.6	102.	115.	128.5	143.5	160.1	170.5
52	14.3	18.	22.6	25.7	32.3	39.1	47.6	54.8	61.2	68.	75.6	90.4	104.	117.4	131.	146.4	163.2	174.
53	14.6	18.3	23.	26.2	33.	39.8	48.5	55.9	62.4	69.4	77.1	92.1	106.	119.6	133.5	149.2	166.5	177.2
54	14.9	18.7	23.4	26.7	33.6	40.6	49.5	57.	63.5	70.6	78.6	94.	108.	121.9	136.	152.	169.6	180.6
55	15.1	19.	23.9	27.2	34.2	41.3	50.4	58.	64.7	72.	80.	95.6	110.	124.1	138.5	155.	172.7	184.
56	15.4	19.4	24.3	27.7	34.9	42.2	51.3	59.1	65.8	73.4	81.5	97.4	112.	126.4	141.	157.5	175.9	187.2
57	15.7	19.7	24.7	28.2	35.4	43.	52.2	60.1	67.	74.5	83.	99.	113.8	128.5	143.2	160.3	179.	190.5
58	16.	20.1	25.1	28.7	36.	43.7	53.2	61.2	68.2	75.9	84.4	100.8	115.9	131.	146.	163.3	182.1	193.7
59	16.2	20.4	25.6	29.2	36.8	44.5	54.	62.2	69.3	77.2	85.8	102.5	118.	133.	148.3	166.	185.1	197.3
60	16.5	20.8	26.	29.7	37.3	45.1	55.	63.3	70.5	78.5	87.3	104.2	119.8	135.4	151.	169.	188.4	201.
61	16.8	21.1	26.4	30.1	37.9	46.	55.9	64.3	71.7	79.8	88.7	105.9	121.9	137.7	153.5	171.5	191.5	203.8

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RADIATING SURFACE OF PIPES.—CONTINUED.

Length of Pipe	SIZE OF PIPE.																	
	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	11	12
	.275	.346	.434	.494	.622	.753	.916	1.055	1.175	1.309	1.455	1.739	1.996	2.257	2.519	2.816	3.14	3.344
62	17	21	27	30	38	46	56	65	72	81	90	107	124	140	156	174	194	207
63	17	21	27	31	39	47	57	66	74	82	91	109	125	142	158	177	197	211
64	17	22	27	31	39	48	58	67	75	83	93	111	127	144	161	180	201	214
65	17	22	28	32	40	49	59	68	76	85	94	113	129	146	163	183	204	217
66	18	22	28	32	41	49	60	69	77	86	96	114	131	149	166	185	207	220
67	18	23	29	33	41	50	61	70	78	87	97	116	133	151	168	188	210	224
68	18	23	29	33	42	51	62	71	80	89	99	118	135	153	171	191	213	227
69	19	23	29	34	42	52	63	72	81	90	100	120	138	155	173	194	216	230
70	19	24	30	34	43	52	64	74	82	91	101	121	139	158	176	197	220	234
71	19	24	30	35	44	53	65	75	83	93	103	123	141	160	178	199	222	237
72	19	24	31	35	44	54	66	76	84	94	104	125	143	162	181	202	226	240
73	20	25	31	36	45	55	67	77	86	95	106	127	146	164	184	205	229	244
74	20	25	32	36	46	55	67	78	87	96	107	128	148	167	186	208	232	248
75	20	26	32	37	46	56	68	79	88	98	109	130	150	169	189	211	235	250
76	20	26	33	37	47	57	69	80	89	99	110	132	152	171	191	214	238	254
77	21	26	33	38	47	58	70	81	90	100	112	134	153	173	193	216	242	257
78	21	27	33	38	48	58	71	82	91	102	113	135	155	176	196	219	245	260
79	21	27	34	39	49	59	72	83	93	103	115	137	158	178	198	222	248	264
80	22	27	34	39	49	60	73	84	94	104	116	139	159	180	201	225	251	268
81	22	28	35	40	50	61	74	85	95	106	117	140	161	182	204	228	254	271
82	22	28	35	40	51	61	75	86	96	107	119	142	163	185	206	230	257	274
83	22	28	36	41	51	62	76	87	97	108	120	144	165	187	209	233	260	278
84	23	29	36	41	52	63	77	88	98	110	122	146	167	189	211	236	264	281
85	23	29	36	42	52	64	78	89	100	111	124	147	169	191	213	239	266	284
86	23	29	37	42	53	64	79	90	101	112	125	149	172	194	216	242	270	288
87	23	30	37	43	54	65	79	91	102	113	126	151	173	196	218	244	273	290
88	24	30	38	43	54	66	80	92	103	115	128	153	175	198	221	247	276	294
89	24	30	38	44	55	67	81	94	104	116	129	155	177	200	224	250	280	298
90	24	31	39	44	56	67	82	95	105	117	131	156	180	203	226	253	282	300
91	25	31	39	45	56	68	83	96	107	119	132	158	181	205	229	256	286	304
92	25	31	39	45	57	69	84	97	108	120	133	160	183	207	231	259	289	308
93	25	32	40	46	57	70	85	98	109	121	135	161	185	209	234	261	292	311
94	25	32	40	46	58	70	86	99	110	122	136	163	187	212	236	264	295	314
95	26	32	41	47	59	71	87	100	111	124	138	165	189	214	239	267	298	318
96	26	33	41	47	59	72	88	101	112	125	139	166	191	216	241	270	301	321
97	26	33	42	48	61	73	89	102	114	126	141	168	193	218	244	273	304	324
98	27	33	42	48	61	77	89	103	115	128	142	170	195	221	246	276	308	328
99	27	34	42	48	61	74	90	104	116	129	144	172	197	223	249	278	310	331
100	27	34	43	49	62	75	91	105	117	131	145	174	199	225	251	281	314	334
110	30	38	47	54	68	83	101	116	129	144	160	191	220	248	276	310	346	368
120	33	41	52	59	74	90	110	126	141	157	174	208	240	270	302	337	397	401
130	35	45	56	64	80	98	119	137	153	170	189	226	259	293	327	365	408	435
140	38	48	60	69	87	105	128	147	164	183	204	243	279	315	352	394	440	468
150	41	52	65	74	93	113	137	158	176	196	218	261	299	338	377	422	471	502
160	44	55	69	79	99	120	146	168	188	209	233	278	320	361	403	450	503	535
170	46	58	73	84	105	128	156	179	200	222	247	295	339	383	427	478	533	568
180	49	62	78	89	112	135	165	189	211	235	262	313	359	406	453	506	565	602
190	52	65	82	94	118	143	174	200	223	249	276	330	380	428	479	535	596	636
200	55	69	86	99	124	150	183	211	235	261	291	348	399	451	503	563	628	670
210	57	72	91	103	130	158	192	221	247	274	305	365	419	474	528	591	659	702
220	60	76	95	108	136	165	201	232	258	288	320	382	440	496	553	618	690	736
230	63	79	99	113	143	173	211	242	270	300	334	400	460	519	579	648	722	770
240	66	83	104	118	149	181	220	253	282	314	349	417	479	541	604	675	753	803
250	68	86	108	123	155	188	229	263	294	327	364	434	499	563	629	704	785	836
260	71	90	112	128	161	195	238	274	306	340	378	452	519	586	654	732	816	870
270	74	93	117	133	168	203	247	285	317	353	393	469	540	609	680	760	848	904
280	77	96	121	138	174	211	257	295	329	366	407	486	559	632	705	788	880	936
290	79	100	125	143	180	218	266	306	341	379	422	504	579	654	730	816	910	970
300	82	103	130	148	186	226	274	316	352	392	436	521	599	677	754	844	942	1003
310	85	107	134	153	193	233	284	327	364	405	451	539	619	699	780	872	973	1036
320	88	111	138	158	199	241	293	337	376	418	465	556	639	722	806	900	1005	1070
330	90	114	143	163	205	248	303	348	388	432	480	573	659	744	830	929	1036	1103
340	93	117	147	168	211	256	312	358	400	444	494	590	679	766	855	957	1068	1137
350	96	121	151	173	217	263	321	369	411	458	510	608	700	790	880	986	1098	1170
360	99	124	156	177	223	271	330	380	423	471	524	625	719	812	906	1013	1130	1204

RADIATING SURFACE OF PIPES—CONTINUED.

Length of Pipe	SIZE OF PIPE.																	
	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	11	12
	.275	.346	.434	.494	.622	.753	.916	1.055	1.175	1.309	1.455	1.739	1.996	2.257	2.519	2.816	3.14	3.344
370	101	128	160	182	230	279	339	390	435	484	538	643	739	835	932	1042	1161	1238
380	105	131	165	188	236	286	349	400	447	497	552	660	759	858	956	1070	1193	1273
390	107	135	169	192	242	294	358	412	458	510	567	678	779	880	982	1096	1224	1305
400	110	138	173	197	248	301	367	422	470	523	582	695	799	901	1006	1125	1257	1338
410	112	141	178	202	255	308	375	432	482	536	596	713	819	926	1032	1153	1287	1370
420	115	145	182	207	261	316	385	443	494	549	611	730	839	948	1056	1182	1318	1405
430	118	148	186	212	267	323	394	453	505	562	625	747	859	970	1082	1210	1350	1438
440	121	152	191	217	274	331	403	464	517	576	640	764	879	993	1107	1238	1380	1472
450	123	155	195	222	280	339	412	475	529	589	654	782	899	1015	1132	1267	1413	1505
460	126	159	199	227	286	346	421	485	540	602	669	800	919	1038	1159	1295	1445	1540
470	129	162	204	232	292	353	430	496	552	615	684	817	939	1060	1183	1322	1476	1572
480	132	166	208	237	298	361	440	506	564	628	698	834	959	1083	1209	1350	1507	1606
490	134	169	212	242	305	368	449	516	576	641	712	850	979	1106	1233	1379	1539	1638
500	137	173	217	247	311	376	458	527	588	654	728	859	999	1128	1258	1407	1570	1672
510	140	176	221	252	317	383	467	538	599	667	742	886	1018	1150	1284	1435	1602	1707
520	143	180	225	257	323	391	476	548	611	680	756	904	1038	1173	1310	1464	1632	1740
530	145	183	230	262	329	398	485	559	623	694	771	921	1058	1195	1333	1492	1664	1773
540	148	187	234	267	336	406	495	570	634	706	786	939	1078	1218	1360	1520	1695	1807
550	151	190	238	271	342	414	504	580	646	720	800	956	1098	1240	1384	1548	1727	1840
560	154	193	243	276	348	421	513	591	658	732	815	973	1118	1264	1410	1577	1759	1874
570	156	197	247	281	354	429	522	601	660	746	829	991	1138	1286	1435	1605	1790	1906
580	159	201	252	286	361	436	531	612	681	759	844	1008	1158	1309	1460	1633	1821	1940
590	162	204	256	291	367	443	540	622	693	772	859	1025	1178	1330	1485	1660	1852	1972
600	165	207	260	296	373	451	550	633	705	784	873	1042	1198	1353	1510	1690	1884	2008
610	177	211	264	301	379	459	559	643	717	798	887	1060	1228	1376	1535	1717	1916	2040
620	170	214	269	306	385	466	568	654	738	811	902	1078	1238	1400	1560	1745	1947	2075
630	173	218	273	311	392	474	577	664	740	824	916	1095	1258	1422	1586	1774	1978	2108
640	176	222	277	316	398	482	586	675	752	838	931	1112	1278	1444	1610	1800	2009	2140
650	179	225	282	321	404	489	595	686	764	850	946	1129	1298	1467	1636	1830	2040	2174
660	181	228	286	326	410	496	604	696	775	863	960	1147	1318	1490	1660	1857	2070	2205
670	184	231	290	330	417	504	614	707	787	877	975	1164	1338	1510	1686	1885	2103	2240
680	187	235	295	336	423	511	622	716	800	890	990	1180	1358	1534	1710	1912	2135	2270
690	189	238	299	341	429	519	632	728	811	902	1004	1199	1378	1557	1738	1942	2168	2308
700	192	242	304	345	435	526	641	738	822	916	1018	1217	1398	1580	1761	1970	2198	2340
710	195	246	308	350	441	534	650	749	834	929	1033	1234	1418	1604	1788	2000	2230	2375
720	198	249	312	355	448	541	660	760	846	942	1047	1251	1438	1625	1812	2026	2260	2409
730	201	252	317	360	454	549	669	770	858	955	1062	1269	1458	1649	1838	2055	2298	2442
740	203	256	321	365	460	556	678	780	870	968	1076	1286	1478	1670	1863	2083	2323	2478
750	206	259	325	370	466	564	686	791	881	982	1091	1303	1498	1692	1888	2110	2355	2510
760	209	263	330	375	473	572	696	802	893	994	1106	1321	1518	1715	1914	2140	2385	2545
770	211	266	334	380	479	579	705	812	905	1007	1120	1338	1538	1738	1938	2168	2418	2578
780	214	270	338	385	485	586	714	822	917	1020	1135	1355	1558	1760	1963	2195	2450	2610
790	217	273	343	390	491	594	724	833	928	1033	1149	1372	1578	1782	1988	2222	2480	2642
800	220	276	347	395	497	602	732	844	940	1047	1163	1390	1598	1805	2012	2250	2511	2678
810	222	280	351	400	504	610	741	854	951	1060	1179	1409	1618	1829	2040	2280	2543	2710
820	225	283	356	405	510	618	750	865	964	1072	1193	1425	1638	1850	2064	2308	2575	2742
830	228	287	360	410	516	624	760	876	976	1086	1208	1442	1658	1872	2090	2335	2605	2775
840	231	290	364	415	522	632	770	886	988	1098	1222	1460	1678	1895	2115	2365	2639	2810
850	233	294	369	420	528	640	778	896	1000	1112	1236	1477	1698	1918	2140	2392	2669	2842
860	236	297	373	424	535	647	788	907	1011	1125	1251	1495	1718	1940	2164	2420	2700	2875
870	239	301	377	429	541	654	797	918	1022	1138	1265	1512	1738	1962	2190	2450	2730	2910
880	242	304	381	434	547	662	806	928	1034	1152	1280	1530	1758	1985	2215	2476	2762	2945
890	244	308	386	439	554	670	815	939	1045	1164	1295	1547	1778	2009	2240	2505	2795	2978
900	247	311	390	444	560	677	824	950	1057	1177	1310	1565	1798	2030	2267	2535	2827	3010
910	250	314	395	449	566	684	833	960	1069	1190	1323	1580	1818	2053	2290	2560	2858	3045
920	253	318	399	454	572	692	843	970	1081	1203	1339	1600	1838	2077	2316	2590	2890	3080
930	255	322	403	459	578	700	852	981	1093	1217	1353	1616	1858	2100	2340	2620	2920	3110
940	258	325	408	464	584	706	860	992	1104	1230	1367	1634	1878	2120	2366	2645	2951	3145
950	261	328	412	469	591	714	870	1001	1116	1243	1382	1651	1898	2144	2391	2675	2982	3180
960	264	332	417	474	597	722	879	1013	1128	1256	1396	1669	1918	2167	2418	2702	3015	3210
970	267	335	421	479	603	730	888	1024	1140	1270	1411	1686	1938	2190	2440	2730	3045	3245
980	269	339	425	484	609	738	897	1034	1151	1282	1425	1703	1958	2210	2468	2758	3077	3278
990	272	342	429	489	616	744	907	1044	1163	1295	1440	1720	1978	2232	2492	2788	3109	3310
1000	275	346	434	494	622	753	916	1055	1175	1309	1455	1739	1998	2257	2519	2816	3140	3344

For amounts over 1000 lineal feet, multiply the number of thousands by the amount in one thousand and to the result add the amount given in these tables for that part of the number less than one thousand.

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FOR CONSERVATORIES AND IRREGULAR SHAPED HOUSES.

It sometimes happens that conservatories are of such irregular shape as to be inconvenient to estimate by the formulas already given, for such as come under this heading I have computed the tables on the following pages so that, at a glance, the amount of glass, or wall surface, in any given space may be obtained.

For explanation of tables see bottom of pages 16 and 17.

To find the area of a triangle look on following tables under an index number, at top of page, equal to one-half the perpendicular line and opposite an index number, at side of page, representing the length of base line, the number found will be the area.

For areas of circles see pages 28 to 30.

Following the tables of glass and wall surface is another giving the square feet of radiation necessary at various rates. Therefore, after having obtained the glass and wall surface it is only necessary to consult these tables to obtain the square feet of radiation necessary.

DIVISORS TO USE FOR DIFFERENT TEMPERATURES.

STEAM								HOT WATER							
TEMPERATURE DESIRED	70°	65°	60°	55°	50°	45°	40°	TEMPERATURE DESIRED	70°	65°	60°	55°	50°	45°	40°
DIVISOR	5	5.4	5.8	6¼	6⅔	7½	8⅓	DIVISOR	3	3¼	3½	3¾	4	4½	5

Reduce all exposed surface to glass or its equivalent and divide by number given under temperature desired, the result will be the number of square feet of radiation necessary to maintain that temperature.

NOTE :—The divisors given above are for heating good tight houses during zero weather. If houses are old, or if they leak air, allow additional radiation sufficient to annul the extra cooling influence.

SQUARE FEET OF GLASS OR WALL

Continued on following

Feet.		1						2						3						4
Inches		12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
Ft.	In.																			
1	12	1																		
	14	1¼	1¼																	
	16	1¼	1½	1½																
	18	1½	1¾	2	2¼															
	20	1¾	2	2¼	2½	2¾														
	22	1¾	2¼	2½	2¾	3	3¼													
2	24	2	2¼	2¾	3	3¼	3¾	4												
	26	2¼	2½	3	3¼	3½	4	4¼	4¾											
	28	2¼	2¾	3¼	3½	4	4¼	4¾	5	5½										
	30	2½	3	3¼	3¾	4¼	4½	5	5½	5¾	6¼									
	32	2¾	3	3¾	4	4½	5	5¼	5¾	6¼	6¾	7								
	34	2¾	3¼	3¾	4¼	4¾	5¼	5¾	6¼	6½	7	7½	8							
3	36	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9						
	38	3¼	3¾	4¼	4¾	5¼	5¾	6¼	6¾	7½	8	8½	9	9½	10					
	40	3½	4	4½	5	5½	6	6¾	7¼	7¾	8¼	9	9½	10	10½	11				
	42	3½	4	4¾	5¼	5¾	6½	7	7½	8¼	8¾	9¼	10	10½	11	11¾	12¼			
	44	3¾	4¼	5	5¾	6¼	6¾	7¼	8	8½	9	9¾	10½	11	11¾	12¼	12¾	13½		
	46	3¾	4½	5	5¾	6½	7	7¾	8¼	9	9½	10¼	10¾	11½	12¼	12¾	13½	14	14¾	
4	48	4	4¾	5¼	6	6¾	7¼	8	8¾	9¼	10	10¾	11¼	12	12¾	13¼	14	14¾	15¼	16
	51	4¼	5	5¾	6½	7	7¾	8½	9¼	9¾	10¾	11¼	12	12¾	13½	14¼	15	15½	16¼	17
	54	4½	5¼	6	6¾	7½	8¼	9	9¾	10½	11¼	12	12¾	13½	14¼	15	15¾	16½	17¼	18
	57	4¾	5½	6¼	7¼	8	8¾	9½	10¼	11	12	12¾	13½	14¼	15	15¾	16¾	17½	18¼	19
5	60	5	5¾	6¾	7½	8¼	9¼	10	10¾	11¾	12½	13¼	14¼	15	15¾	16¾	17½	18¼	19¼	20
	64	5¼	6¼	7	8	9	9¾	10¾	11½	12½	13¼	14¼	15	16	17	17¾	18¾	19½	20½	21¼
	68	5¾	6½	7½	8½	9½	10½	11¼	12¼	13¼	14¼	15	16	17	18	19	19¾	20¾	21¾	22¾
6	72	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	76	6¼	7½	8½	9½	10½	11½	12¾	13¾	14¾	15¾	17	18	19	20	21	22¼	23¼	24¼	25¼
	80	6¾	7¾	9	10	11	12¼	13¼	14½	15½	16¾	17¾	19	20	21	22¼	23¼	24½	25½	26¾
7	84	7	8¼	9¼	10½	11¾	12¾	14	15¼	16¼	17½	18¾	19¾	21	22¼	23¼	24½	25¾	26¾	28
	88	7¼	8½	9¾	11	12¼	13½	14¾	16	17	18¼	19½	20¾	22	23¼	24½	25¾	27	28	29¼
	92	7¾	9	10¼	11¾	12¾	14	15¼	16½	18	19¼	20½	21¾	23	24¼	25½	26¾	28	29½	30¾
8	96	8	9¼	10¾	12	13¼	14¾	16	17¼	18¾	20	21¼	22¾	24	25¼	26¾	28	29¼	30¾	32
	100	8¼	9¾	11	12½	14	15¼	16¾	18	19½	20¾	22¼	23½	25	26½	27¾	29¼	30½	32	33¼
	104	8¾	10	11½	13	14½	16	17¼	18¾	20¼	21¾	23	24½	26	27½	29	30¼	31¾	33¼	34¾
9	108	9	10½	12	13½	15	16½	18	19½	21	22½	24	25½	37	28½	30	31½	33	34½	36
	112	9¼	11	12½	14	15½	17	18¾	20¼	21¾	23¼	24¾	26½	28	29½	31	32¾	34¼	35¼	37¼
	116	9¾	11¼	13	14½	16	17¾	19¼	21	22½	24¼	25¾	27½	29	30¾	32¼	33¾	35½	37	38¾
10	120	10	11¾	13¼	15	16¾	18¼	20	21¾	23¼	25	26¾	28¼	30	31¾	33¼	35	36¾	38	40
	124	10¼	12	13¾	15½	17¼	19	20¾	22½	24	25¾	27½	29¼	31	32¾	34½	36¼	38	39½	41¼
	128	10¾	12½	14¼	16	17¾	19½	21¼	23	25	26¾	28½	30¼	32	33¾	35½	37¼	39	41	42¾
11	132	11	12¾	14¾	16½	18¼	20¼	22	23¾	25¾	27½	29¼	31¼	33	34¾	36¾	38½	40¼	42¼	44
	136	11¼	13¼	15	17	19	20¾	22¾	24½	26½	28¼	30¼	32	34	36	37¾	39¾	41½	43½	45¼
	140	11¾	13½	15½	17½	19½	21½	23¼	25¼	27¼	29¼	31	33	35	37	38¾	40¾	42¾	44¾	46¾
12	144	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
	148	12¼	14½	16½	18½	20½	22½	24¾	26¾	28¾	30¾	33	35	37	39	41	43¼	45¼	47¼	49¼
	152	12¾	14¾	17	19	21	23¼	25¼	27½	29½	31¾	33¾	36	38	40	42¼	44¼	46½	48½	50¾
13	156	13	15¼	17¼	19½	21¾	23¾	26	28¼	30¼	32½	34¾	36¾	39	41¼	43¼	45½	47¾	49¾	52
	160	13¼	15½	17¾	20	22¼	24½	26¾	29	31	33¼	35½	37¾	40	42¼	44½	46¾	49	51	53¼
	164	13¾	16	18¼	20½	22¾	25	27¼	29½	32	34	36½	38¾	41	43¼	45½	47¾	50	52½	54¾
14	168	14	16¼	18¾	21	23¼	25¾	28	30¼	32¾	35	37¼	39¾	42	44¼	46¾	49	51¼	53¾	56
	172	14¼	16¾	19	21½	24	26¼	28¾	31	33½	35¾	38½	40½	43	45½	47¾	50¼	52½	55	57¼
	176	14¾	17	19½	22	24½	27	29¼	31¾	34¼	36¾	39	41½	44	46½	49	51¼	53¾	56¼	58¾
15	180	15	17½	20	22½	25	27½	30	32½	35	37½	40	42½	45	47½	50	52½	55	57½	60
	184	15¼	18	20½	23	25½	28	30¾	33½	35¾	38¼	41	43½	46	48½	51	53¾	56¼	58¾	61¼
	188	15¾	18¼	21	23½	26	28¾	31¼	34	36½	39¼	41¾	44½	47	49½	52¼	54¾	57½	60	62¾
16	192	16	18¾	21¼	24	26¾	29¼	32	34¾	37¼	40	42¾	45¼	48	50¾	53¼	56	58¾	61¼	64
	196	16¼	19	21¾	24½	27¼	30	32¾	35½	38	40¾	43½	46¼	49	51¾	54½	57¼	60	62½	65¼
	200	16¾	19½	22¼	25	27¾	30½	33¼	36	39	41¾	44½	47¼	50	52¾	55½	58¼	61	64	66¾
17	204	17	19¾	22¾	25½	28¼	31¼	34	36¾	39¾	42½	45¼	48¼	51	53¾	56¾	59½	62¼	65¼	68

NOTE: Always take numbers at the top for the height and numbers at the side for the length. Follow down the column under the heighth until you come exactly opposite the length, and where the imaginary lines cross you will find the number of square feet. No fractions less than ½ are used. For convenience this table is indexed both in

SURFACE 12 X 17 FEET AND SMALLER.

pages see note.

Feet.					5						7			8			9			10			1		12
Inches		51	54	57	60	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	128	132	136	144
Ft.	In.																								
	51	17																							
	54	19	20																						
	57	20	21	22																					
5	60	21	22	23	25																				
	64	22	24	25	26	28																			
	68	24	25	27	28	30	31																		
6	72	25	27	28	30	32	34	36																	
	76	27	28	30	31	33	36	38	40																
	80	28	30	3i	33	35	37	40	42	44															
7	84	29	31	33	35	37	39	42	44	46	49														
	88	31	33	34	36	39	41	44	46	49	51	53													
	92	32	34	36	38	41	43	46	48	51	53	56	58												
8	96	34	36	38	40	42	45	48	50	53	56	58	61	64											
	100	35	37	39	41	44	47	50	52	55	58	61	64	66											
	104	36	39	41	43	46	49	52	55	57	60	63	66	69	72										
9	108	38	40	42	45	48	51	54	57	60	63	66	69	72	75	78									
	112	39	42	44	46	49	53	56	59	62	65	68	71	74	77	81	84								
	116	41	43	46	48	51	54	58	61	64	67	71	74	77	80	83	87	90							
10	120	42	45	47	50	53	56	60	63	66	70	73	76	80	83	86	90	93	96						
	124	43	46	49	51	55	58	62	65	69	72	75	79	82	86	89	93	96	100	103					
	128	45	48	50	53	57	60	64	67	71	74	78	81	85	89	92	96	99	103	106	110				
11	132	46	49	52	55	58	92	66	69	73	77	80	84	88	91	95	99	102	106	110	113	117			
	136	48	51	53	56	60	64	68	71	75	79	83	87	90	94	98	102	105	109	113	127	121	124		
	140	49	52	55	58	62	66	70	74	77	81	85	89	93	97	101	105	109	112	116	121	125	129	132	
12	144	51	54	57	60	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	128	132	136	144
	148	52	55	58	61	65	70	74	78	82	86	90	94	98	102	107	111	115	119	123	127	131	135	139	148
	152	53	57	60	63	67	71	76	80	84	88	93	97	101	105	109	114	118	122	126	131	136	140	144	152
13	156	55	58	61	65	69	73	78	82	86	91	95	99	104	108	112	117	121	125	130	134	138	143	147	156
	160	56	60	63	66	71	75	80	84	89	93	97	102	106	111	115	120	124	129	133	137	142	146	151	160
	164	58	61	65	68	72	77	82	86	91	95	100	104	109	114	118	123	137	132	136	141	145	150	155	164
14	168	59	63	66	70	74	79	84	88	93	98	102	107	112	116	121	126	130	135	140	144	149	154	158	168
	172	61	64	68	71	76	81	86	90	95	100	105	110	114	119	124	129	133	138	143	148	153	157	162	172
	176	62	66	69	73	78	83	88	93	97	102	107	112	117	122	127	132	137	141	146	151	156	161	166	176
15	180	63	67	71	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	180
	184	65	69	72	76	81	87	92	97	102	107	112	117	122	127	133	138	143	148	153	158	163	168	173	184
	188	66	70	74	78	83	88	94	99	104	109	115	120	125	130	135	141	146	151	156	162	167	172	177	188
16	192	68	72	76	80	85	90	96	101	106	112	117	122	128	133	138	144	149	154	160	165	170	176	181	192
	196	69	73	77	81	87	92	98	103	109	114	119	125	130	136	141	147	152	158	163	168	174	179	185	196
	200	70	75	79	83	89	94	100	105	111	116	122	127	133	139	144	150	155	161	166	172	177	183	189	200
17	204	72	76	80	85	90	96	102	107	113	119	121	130	136	141	147	153	158	164	170	175	181	187	192	204

feet and inches and they can be used independently or together and the answer found is always square feet. For example, it makes no difference whether you say 3 ft. x 42 in., 36 in. x 3½ ft. or 3 ft x 3½ ft., all mean the same, and by consulting the table you will find in each case the result obtained, 10½ sq. ft. is the same. Fractions of 1 sq. ft. not given in the above table.

SQUARE FEET OF GLASS OR WALL

SEE NOTE,

	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13	13½	14	14½	15
10½	63	68	73	78	84	89	94	99	105	110									
11	66	71	77	82	88	93	99	104	110	115	121								
11½	69	74	80	86	92	97	103	109	115	120	126	132							
12	72	78	84	90	96	102	108	114	120	126	132	138							
12½	75	81	87	93	100	106	112	118	125	131	137	143	150						
13	78	84	91	96	104	110	117	123	130	136	143	149	156	162	169				
13½	81	87	94	101	108	114	121	128	135	141	148	155	162	168	175	182			
14	84	91	98	105	112	119	126	133	140	147	154	161	168	175	182	189	196		
14½	87	94	101	108	116	123	130	137	145	152	159	166	174	181	188	195	203		
15	90	97	105	112	120	127	135	142	150	157	165	172	180	187	195	202	210	217	225
15½	93	101	108	116	124	131	139	147	155	162	170	178	186	193	201	209	217	224	232
16	96	104	112	120	128	136	144	152	160	168	176	184	192	200	208	216	224	232	240
16½	99	107	115	123	132	140	148	157	165	173	181	189	198	206	214	222	231	239	247
17	102	110	119	127	136	144	153	161	170	178	187	195	204	212	221	229	238	246	255
17½	105	114	122	131	140	149	157	166	175	183	192	201	210	218	227	236	245	253	262
18	108	117	126	135	144	153	162	171	180	189	198	207	216	225	234	243	252	261	270
18½	111	120	129	138	148	157	166	176	185	194	203	212	222	231	240	249	259	268	277
19	114	123	133	142	152	161	171	180	190	199	209	218	228	237	247	256	266	275	285
19½	117	127	136	146	156	165	175	185	195	204	214	224	234	243	253	263	273	282	292
20	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
21	126	136	147	157	168	178	189	199	210	220	231	241	252	262	273	283	294	304	315
22	132	143	154	165	176	187	198	209	220	231	242	253	264	275	286	297	308	319	330
23	138	149	161	172	184	195	207	218	230	241	253	264	276	287	299	310	322	333	345
24	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312	324	336	348	360
25	150	162	175	187	200	212	225	237	250	262	275	287	300	312	325	337	350	362	375
26	156	169	182	195	208	221	234	247	260	273	286	299	312	325	338	351	364	377	390
27	162	175	189	202	216	229	243	256	270	283	297	310	324	337	351	364	378	391	405
28	168	182	196	210	224	238	252	266	280	294	308	322	336	350	364	378	392	406	420
29	174	188	203	217	232	246	261	275	290	304	319	333	348	362	377	391	406	420	435
30	180	195	210	225	240	255	270	285	300	315	330	345	360	375	390	405	420	435	450
31	186	201	217	232	248	263	279	294	310	325	341	356	372	387	403	418	434	449	465
32	192	208	224	240	256	272	288	304	320	336	352	368	384	400	416	432	448	464	480
33	198	214	231	247	264	280	297	313	330	346	363	379	396	412	429	445	462	478	495
34	204	221	238	255	272	289	306	323	340	357	374	391	408	425	442	459	476	493	510
35	210	227	245	262	280	297	315	333	350	367	385	402	420	437	455	472	490	507	525
36	216	234	252	270	288	306	324	342	360	378	396	414	432	450	468	486	504	522	540
37	222	240	259	277	296	314	333	351	370	388	407	425	444	462	481	499	518	536	555
38	228	247	266	285	304	323	342	361	380	399	418	437	456	475	494	513	532	551	570
39	234	253	273	292	312	331	351	370	390	409	429	448	468	487	507	526	546	565	585
40	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600
41	246	266	287	307	328	348	369	389	410	430	451	471	492	512	533	553	574	594	615
42	252	273	294	315	336	357	378	399	420	441	462	483	504	525	546	567	588	609	630
43	258	279	301	322	344	365	387	408	430	451	473	494	516	537	559	580	602	623	645
44	264	286	308	330	352	374	396	418	440	462	484	506	528	550	572	594	616	638	660
45	270	292	315	337	360	382	405	427	450	472	495	517	540	562	585	607	630	652	675
46	276	299	322	345	368	391	414	437	460	483	506	529	552	575	598	621	644	667	690
47	282	305	329	352	376	399	423	446	470	493	517	540	564	587	611	634	658	681	705
48	288	312	336	360	384	408	432	456	480	504	528	552	576	600	624	648	672	696	720
49	294	318	343	367	392	416	441	465	490	514	539	563	588	612	637	661	686	710	735
50	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750
51	306	331	357	382	408	433	459	484	510	535	561	586	612	637	663	688	714	739	765
52	312	338	364	390	416	442	468	494	520	546	572	598	624	650	676	702	728	754	780
53	318	344	371	397	424	450	477	503	530	556	583	609	636	662	689	715	742	768	795
54	324	351	378	405	432	459	486	513	540	567	594	621	648	675	702	729	756	783	810
55	330	357	385	412	440	467	495	522	550	577	605	632	660	707	715	742	770	797	825
56	336	364	392	420	448	476	504	532	560	588	616	644	672	700	728	756	784	812	840
57	342	370	399	427	456	484	513	541	570	598	627	655	684	712	741	769	798	826	855
58	348	377	406	435	464	493	522	551	580	609	638	667	696	725	754	783	812	841	870
59	354	383	413	442	472	501	531	560	590	619	649	678	708	737	767	796	826	855	885
60	360	390	420	450	480	510	540	570	600	630	660	690	720	750	780	810	840	870	900
61	366	397	427	457	488	518	549	579	610	640	671	701	732	762	793	823	854	884	915
62	372	403	434	465	496	527	558	589	620	651	682	713	744	775	806	837	868	899	930
63	378	409	441	472	504	535	567	598	630	661	693	724	756	787	819	850	882	913	945
64	384	415	448	480	512	544	576	608	640	672	704	736	768	800	832	864	896	928	960
65	390	422	455	487	520	552	585	617	650	682	715	747	780	812	845	877	910	942	975

SURFACE FROM 6X10 FT. TO 25X65 FT.

PAGES 62 AND 63.

	15½	16	16½	17	17½	18	18½	19	19½	20	20½	21	21½	22	22½	23	23½	24	24½	25
15½	240																			
16	248	256																		
16½	255	264	272																	
17	263	272	280																	
17½	271	280	288	297																
18	279	288	297	306	315	324														
18½	286	296	305	314	323	333	342													
19	294	304	313	323	332	342	351													
19½	302	312	321	331	341	351	360	370	380	390										
20	310	320	330	340	350	360	370	380	390	400										
21	325	336	346	357	367	378	388	399	409	420	430	441								
22	341	352	363	374	385	396	407	418	429	440	451	462	471	484						
23	356	368	379	391	402	414	425	437	448	460	471	483	495	506	517	529				
24	372	384	396	408	420	432	444	456	468	480	482	504	516	528	540	552	564	576		
25	387	400	412	425	437	450	462	475	487	500	512	525	533	550	563	575	587	600	613	625
26	403	416	429	442	455	468	481	494	507	520	533	546	559	572	585	598	611	624	637	650
27	418	432	445	459	472	486	499	513	526	540	553	567	580	594	607	621	634	648	661	675
28	434	448	462	476	490	504	518	532	546	560	574	588	602	616	630	644	658	672	686	700
29	449	464	478	493	507	522	536	551	565	580	594	609	623	638	652	667	681	696	710	725
30	465	480	495	510	525	540	555	570	585	600	615	630	645	660	675	690	705	720	735	750
31	480	496	511	527	542	558	573	589	604	620	635	651	667	682	698	713	729	744	760	775
32	496	512	528	544	560	576	592	608	624	640	656	672	688	704	720	736	752	768	784	800
33	511	528	544	561	577	594	610	627	643	660	676	693	709	726	742	759	775	792	808	825
34	527	544	561	578	595	612	629	646	663	680	697	714	731	748	765	782	799	816	833	850
35	542	560	577	595	612	630	647	665	682	700	717	735	752	770	787	805	822	840	857	875
36	558	576	594	612	630	648	666	684	702	720	738	756	774	792	810	828	846	864	882	900
37	573	592	610	629	647	666	684	703	721	740	758	777	795	814	832	851	869	880	898	925
38	589	608	627	646	665	684	703	722	741	760	779	798	817	836	855	874	893	912	931	950
39	604	624	643	663	682	702	721	741	760	780	799	819	839	858	878	897	917	936	956	975
40	620	640	660	680	700	720	740	760	780	800	820	840	860	880	900	920	940	960	980	1000
41	635	656	676	697	717	738	758	779	799	820	840	861	882	902	923	944	964	985	1004	1025
42	651	672	693	714	735	756	777	798	819	840	860	882	903	924	945	966	987	1008	1029	1050
43	666	688	709	731	752	774	795	817	838	860	881	903	924	946	967	989	1010	1032	1053	1075
44	682	704	726	748	770	792	814	836	858	880	901	924	946	968	990	1012	1034	1056	1078	1100
45	697	720	742	765	787	810	832	855	877	900	922	945	967	990	1012	1035	1057	1080	1102	1125
46	713	736	759	782	805	828	851	874	897	920	942	966	989	1012	1035	1058	1081	1104	1137	1150
47	728	752	775	799	822	846	869	893	916	940	963	987	1010	1034	1057	1081	1104	1128	1151	1175
48	744	768	792	816	840	864	888	912	936	960	983	1008	1032	1056	1080	1104	1128	1152	1176	1200
49	759	784	808	833	857	882	906	931	955	980	1004	1029	1053	1078	1102	1127	1151	1176	1200	1225
50	775	800	825	850	875	900	925	950	975	1000	1025	1050	1075	1100	1125	1150	1175	1200	1225	1250
51	790	816	841	867	892	918	943	969	994	1020	1046	1071	1096	1122	1147	1173	1198	1224	1250	1275
52	806	832	858	884	910	936	962	988	1014	1040	1066	1092	1118	1144	1170	1196	1222	1248	1274	1300
53	821	848	874	901	927	954	980	1007	1033	1060	1086	1113	1139	1166	1192	1219	1255	1272	1298	1325
54	837	864	891	918	945	972	999	1026	1053	1080	1107	1134	1161	1188	1215	1242	1269	1296	1323	1350
55	852	880	907	935	962	990	1017	1045	1072	1100	1127	1155	1182	1210	1237	1265	1292	1320	1347	1375
56	868	896	924	952	980	1008	1036	1064	1092	1120	1148	1176	1202	1232	1260	1288	1316	1344	1372	1400
57	883	912	940	969	997	1026	1054	1083	1111	1140	1168	1197	1225	1254	1282	1311	1339	1368	1396	1425
58	899	928	957	986	1015	1044	1073	1102	1131	1160	1189	1218	1247	1276	1315	1334	1363	1392	1421	1450
59	914	944	973	1003	1032	1062	1091	1121	1150	1180	1209	1239	1268	1298	1327	1357	1386	1416	1445	1475
60	930	960	990	1020	1050	1080	1110	1140	1170	1200	1230	1260	1290	1320	1350	1380	1420	1440	1470	1500
61	945	976	1006	1037	1067	1098	1128	1159	1189	1220	1250	1281	1311	1342	1372	1403	1433	1464	1494	1525
62	961	992	1023	1054	1085	1116	1147	1178	1209	1240	1271	1302	1333	1364	1395	1426	1457	1488	1519	1550
63	976	1008	1039	1071	1102	1134	1165	1197	1228	1260	1291	1323	1354	1386	1417	1449	1480	1512	1553	1575
64	992	1024	1056	1088	1120	1152	1184	1216	1248	1280	1312	1344	1376	1408	1440	1472	1504	1536	1568	1600
65	1007	1040	1072	1105	1137	1170	1202	1235	1267	1300	1333	1365	1397	1430	1462	1495	1527	1550	1582	1625

SQUARE FEET OF GLASS OR WALL

	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13	13½	14	14½	15	15½
56	336	364	392	420	448	476	504	532	560	588	616	644	672	700	728	756	784	812	840	868
57	342	371	399	428	456	485	513	542	570	599	627	656	684	713	741	770	798	827	855	884
58	348	377	406	435	464	493	522	551	580	609	638	667	696	725	754	783	812	841	870	899
59	354	384	413	443	472	502	531	561	590	620	649	679	708	738	767	797	826	856	885	915
60	360	390	420	450	480	510	540	570	600	630	660	690	720	750	780	810	840	870	900	930
61	366	397	427	458	488	519	549	580	610	641	671	702	732	763	793	824	854	885	915	946
62	372	403	434	465	496	527	558	589	620	651	682	713	744	775	806	837	868	899	930	961
63	378	410	441	473	504	536	567	599	630	662	693	725	756	788	819	851	882	914	945	977
64	384	416	448	480	512	544	576	608	640	672	704	736	768	800	832	864	896	928	960	992
65	390	423	455	488	520	553	585	618	650	683	715	748	780	813	845	878	910	943	975	1008
66	396	429	462	495	528	561	594	627	660	693	726	759	792	825	858	891	924	957	990	1023
67	402	436	469	503	536	570	603	637	670	704	737	771	804	838	871	905	938	972	1005	1039
68	408	442	476	510	544	578	612	646	680	714	748	782	816	850	884	918	952	986	1020	1054
69	414	449	483	518	552	587	621	656	690	725	759	794	828	863	897	932	966	1001	1035	1070
70	420	455	490	525	560	595	630	665	700	735	770	805	840	875	910	945	980	1015	1050	1085
71	426	462	497	533	568	604	639	675	710	746	781	817	852	888	923	959	994	1030	1065	1101
72	432	468	504	540	576	612	648	684	720	756	792	828	864	900	936	972	1008	1044	1080	1116
73	438	475	511	548	584	621	657	694	730	767	803	840	876	913	949	986	1022	1059	1095	1132
74	444	481	518	555	592	629	666	703	740	777	814	851	888	925	962	999	1036	1073	1110	1147
75	450	488	525	563	600	638	675	713	750	788	825	863	900	938	975	1013	1050	1088	1125	1163
76	456	494	532	570	608	646	684	722	760	798	836	874	912	950	988	1026	1064	1102	1140	1178
77	462	501	539	578	616	655	693	732	770	809	847	886	924	963	1001	1040	1078	1117	1155	1194
78	468	507	546	585	624	663	702	741	780	819	858	897	936	975	1014	1053	1092	1131	1170	1209
79	474	514	553	593	632	672	711	751	790	830	869	909	948	988	1027	1067	1106	1146	1185	1225
80	480	520	560	600	640	680	720	760	800	840	880	920	960	1000	1040	1080	1120	1160	1200	1240
81	486	527	567	608	648	689	729	770	810	851	891	932	972	1013	1053	1094	1134	1175	1215	1256
82	492	533	574	615	656	697	738	779	820	861	902	943	984	1025	1066	1107	1148	1189	1230	1271
83	498	540	581	623	664	706	747	789	830	872	913	955	996	1038	1079	1121	1162	1204	1245	1287
84	504	546	588	630	672	714	756	798	840	882	924	966	1008	1050	1092	1134	1176	1218	1260	1302
85	510	553	595	638	680	723	765	808	850	893	935	978	1020	1063	1105	1148	1190	1233	1275	1318
86	516	559	602	645	688	731	774	817	860	903	946	989	1032	1075	1118	1161	1204	1247	1290	1333
87	522	566	609	653	696	740	783	827	870	914	957	1001	1044	1088	1131	1175	1218	1262	1305	1349
88	528	572	616	660	704	748	792	836	880	924	968	1012	1056	1100	1144	1188	1232	1276	1320	1364
89	534	579	623	668	712	757	801	846	890	935	979	1024	1068	1113	1157	1202	1246	1291	1335	1380
90	540	585	630	675	720	765	810	855	900	945	990	1035	1080	1125	1170	1215	1260	1305	1350	1395
91	546	592	637	683	728	774	819	865	910	956	1001	1047	1092	1138	1183	1229	1274	1320	1365	1411
92	552	598	644	690	736	782	828	874	920	966	1012	1058	1104	1150	1196	1242	1288	1334	1380	1426
93	558	605	651	698	744	791	837	884	930	977	1023	1070	1116	1163	1209	1256	1302	1349	1395	1442
94	564	611	658	705	752	799	846	893	940	987	1034	1081	1128	1175	1222	1269	1316	1363	1410	1457
95	570	618	665	713	760	808	855	903	950	998	1045	1093	1140	1188	1235	1283	1330	1378	1425	1473
96	576	624	672	720	768	816	864	912	960	1008	1056	1104	1152	1200	1248	1296	1344	1392	1440	1488
97	582	631	679	728	776	825	873	922	970	1019	1067	1116	1164	1213	1261	1310	1358	1407	1455	1504
98	588	637	686	735	784	833	882	931	980	1029	1078	1127	1176	1225	1274	1323	1372	1421	1470	1519
99	594	644	693	743	792	842	891	941	990	1040	1089	1139	1188	1238	1287	1337	1386	1436	1485	1535
100	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550
105	630	683	735	788	840	893	945	998	1050	1103	1155	1208	1260	1313	1365	1418	1470	1523	1575	1628
110	660	715	770	825	880	935	990	1045	1100	1155	1210	1265	1320	1375	1430	1485	1540	1595	1650	1705
115	690	748	805	863	920	978	1035	1093	1150	1208	1265	1323	1380	1438	1495	1553	1610	1668	1725	1783
120	720	780	840	900	960	1020	1080	1140	1200	1260	1320	1380	1440	1500	1560	1620	1680	1740	1800	1860
125	750	813	875	938	1000	1063	1125	1188	1250	1313	1375	1438	1500	1563	1625	1688	1750	1813	1875	1938
130	780	845	910	975	1040	1105	1170	1235	1300	1365	1430	1495	1560	1625	1690	1755	1820	1885	1950	2015
135	810	878	945	1013	1080	1148	1215	1283	1350	1418	1485	1553	1620	1688	1755	1823	1890	1958	2025	2093
140	840	910	980	1050	1120	1190	1260	1330	1400	1470	1540	1610	1680	1750	1820	1890	1960	2030	2100	2170
145	870	943	1015	1088	1160	1233	1305	1378	1450	1523	1595	1668	1740	1813	1885	1958	2030	2103	2175	2248
150	900	975	1050	1125	1200	1275	1350	1425	1500	1575	1650	1725	1800	1875	1950	2025	2100	2175	2250	2325
155	930	1008	1085	1163	1240	1318	1395	1473	1550	1628	1705	1783	1860	1938	2015	2093	2170	2248	2325	2403
160	960	1040	1120	1200	1280	1360	1440	1520	1600	1680	1760	1840	1920	2000	2080	2160	2240	2320	2400	2480
165	990	1073	1155	1238	1320	1403	1485	1568	1650	1733	1815	1898	1980	2063	2145	2228	2310	2393	2475	2558
170	1020	1105	1190	1275	1360	1445	1530	1615	1700	1785	1870	1955	2040	2125	2210	2295	2380	2465	2550	2635
175	1050	1138	1225	1313	1400	1488	1575	1663	1750	1838	1925	2013	2100	2188	2275	2363	2450	2538	2625	2713
180	1080	1170	1260	1350	1440	1530	1620	1710	1800	1890	1980	2070	2160	2250	2340	2430	2520	2610	2700	2790
185	1110	1203	1295	1388	1580	1573	1665	1758	1850	1943	2035	2128	2220	2313	2405	2498	2590	2683	2775	2868
190	1140	1235	1330	1425	1520	1615	1710	1805	1900	1995	2090	2185	2280	2375	2470	2565	2660	2755	2850	2945
195	1170	1268	1365	1463	1560	1658	1755	1853	1950	2048	2145	2243	2340	2438	2535	2633	2730	2828	2925	3023
200	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100

SURFACE 6X56 FEET AND LARGER.

	16	16½	17	17½	18	18½	19	19½	20	20½	21	22	23	24	25	26	27	28	29	30
56	896	924	952	980	1008	1036	1064	1092	1120	1148	1176	1232	1288	1344	1400	1456	1512	1568	1624	1680
57	912	941	969	998	1026	1055	1083	1112	1140	1169	1197	1254	1311	1368	1425	1482	1539	1596	1653	1710
58	928	957	986	1015	1044	1073	1102	1131	1160	1189	1218	1276	1334	1392	1450	1508	1566	1624	1682	1740
59	944	974	1003	1033	1062	1092	1121	1151	1180	1210	1239	1298	1357	1416	1475	1534	1593	1652	1711	1770
60	960	990	1020	1050	1080	1110	1140	1170	1200	1230	1260	1320	1380	1440	1500	1560	1620	1680	1740	1800
61	976	1007	1037	1068	1098	1129	1159	1190	1220	1251	1281	1342	1403	1464	1525	1586	1647	1708	1769	1830
62	992	1023	1054	1085	1116	1147	1178	1209	1240	1271	1302	1364	1426	1488	1550	1612	1674	1736	1798	1860
63	1008	1040	1071	1103	1134	1166	1197	1229	1260	1292	1323	1386	1449	1512	1575	1638	1701	1764	1827	1890
64	1024	1056	1088	1120	1152	1184	1216	1248	1280	1312	1344	1408	1472	1536	1600	1664	1728	1792	1856	1920
65	1040	1073	1105	1138	1170	1203	1235	1268	1300	1333	1365	1430	1495	1560	1625	1690	1755	1820	1885	1950
66	1056	1089	1122	1155	1188	1221	1254	1287	1320	1353	1386	1452	1518	1584	1650	1716	1782	1848	1914	1980
67	1072	1106	1139	1173	1206	1240	1273	1307	1340	1374	1407	1474	1541	1608	1675	1742	1809	1876	1943	2010
68	1088	1122	1156	1190	1224	1258	1292	1326	1360	1394	1428	1496	1564	1632	1700	1768	1836	1904	1972	2040
69	1104	1139	1173	1208	1242	1277	1311	1346	1380	1415	1449	1518	1587	1656	1725	1794	1863	1932	2001	2070
70	1120	1155	1190	1225	1260	1295	1330	1365	1400	1435	1470	1540	1610	1680	1750	1820	1890	1960	2030	2100
71	1136	1172	1207	1243	1278	1314	1349	1385	1420	1456	1491	1562	1633	1704	1775	1846	1917	1988	2059	2130
72	1152	1188	1224	1260	1296	1332	1368	1404	1440	1476	1512	1584	1656	1728	1800	1872	1944	2016	2088	2160
73	1168	1205	1241	1278	1314	1351	1387	1424	1460	1497	1533	1606	1679	1752	1825	1898	1971	2044	2117	2190
74	1184	1221	1258	1295	1332	1369	1406	1443	1480	1517	1554	1628	1702	1776	1850	1924	1998	2072	2146	2220
75	1200	1238	1275	1313	1350	1388	1425	1463	1500	1538	1575	1650	1725	1800	1875	1950	2025	2100	2175	2250
76	1216	1254	1292	1330	1368	1406	1444	1482	1520	1558	1596	1672	1748	1824	1900	1976	2052	2128	2204	2280
77	1232	1271	1309	1348	1386	1425	1463	1502	1540	1579	1617	1694	1771	1848	1925	2002	2079	2156	2233	2310
78	1248	1287	1326	1365	1404	1443	1482	1521	1560	1599	1638	1716	1794	1872	1950	2028	2106	2184	2262	2340
79	1264	1304	1343	1383	1422	1462	1501	1541	1580	1620	1659	1738	1817	1896	1975	2054	2133	2212	2291	2370
80	1280	1320	1360	1400	1440	1480	1520	1560	1600	1640	1680	1760	1840	1920	2000	2080	2160	2240	2320	2400
81	1296	1337	1377	1418	1458	1499	1539	1580	1620	1661	1701	1782	1863	1944	2025	2106	2187	2268	2349	2430
82	1312	1353	1394	1435	1476	1517	1558	1599	1640	1681	1722	1804	1886	1968	2050	2132	2214	2296	2378	2460
83	1328	1370	1411	1453	1494	1536	1577	1619	1660	1702	1743	1826	1909	1992	2075	2158	2241	2324	2407	2490
84	1344	1386	1428	1470	1512	1554	1596	1638	1680	1722	1764	1848	1932	2016	2100	2184	2268	2352	2436	2520
85	1360	1403	1445	1488	1530	1573	1615	1658	1700	1743	1785	1870	1955	2040	2125	2210	2295	2380	2465	2550
86	1376	1419	1462	1505	1548	1591	1634	1677	1720	1763	1806	1892	1978	2064	2150	2236	2322	2408	2494	2580
87	1392	1436	1479	1523	1566	1610	1653	1697	1740	1784	1827	1914	2001	2088	2175	2262	2349	2436	2523	2610
88	1408	1452	1496	1540	1584	1628	1672	1716	1760	1804	1848	1936	2024	2112	2200	2288	2376	2464	2552	2640
89	1424	1469	1513	1558	1602	1647	1691	1736	1780	1825	1869	1958	2047	2136	2225	2314	2403	2492	2581	2670
90	1440	1485	1530	1575	1620	1665	1710	1755	1800	1845	1890	1980	2070	2160	2250	2340	2430	2520	2610	2700
91	1456	1502	1547	1593	1638	1684	1729	1775	1820	1866	1911	2002	2093	2184	2275	2366	2457	2548	2639	2730
92	1472	1518	1564	1610	1656	1702	1748	1794	1840	1886	1932	2024	2116	2208	2300	2392	2484	2576	2668	2760
93	1488	1535	1581	1628	1674	1721	1767	1814	1860	1907	1953	2046	2139	2232	2325	2418	2511	2604	2697	2790
94	1504	1551	1598	1645	1692	1739	1786	1833	1880	1927	1974	2068	2162	2256	2350	2444	2538	2632	2726	2820
95	1520	1568	1615	1663	1710	1758	1805	1853	1900	1948	1995	2090	2185	2280	2375	2470	2565	2660	2755	2850
96	1536	1584	1632	1680	1728	1776	1824	1872	1920	1968	2016	2112	2208	2304	2400	2496	2592	2688	2784	2880
97	1552	1601	1649	1698	1746	1795	1843	1892	1940	1989	2037	2134	2231	2328	2425	2522	2619	2716	2813	2910
98	1568	1617	1666	1715	1764	1813	1862	1911	1960	2009	2058	2156	2254	2352	2450	2548	2646	2744	2842	2940
99	1584	1634	1683	1733	1782	1832	1881	1931	1980	2030	2079	2178	2277	2376	2475	2574	2673	2772	2871	2970
100	1600	1650	1700	1750	1800	1850	1900	1950	2000	2050	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
105	1680	1733	1785	1838	1890	1943	1995	2048	2100	2153	2205	2310	2415	2520	2625	2730	2835	2940	3045	3150
110	1760	1815	1870	1925	1980	2035	2090	2145	2200	2255	2310	2420	2530	2640	2750	2860	2970	3080	3190	3300
115	1840	1898	1955	2013	2070	2128	2185	2243	2300	2358	2415	2530	2645	2760	2875	2990	3105	3220	3335	3450
120	1920	1980	2040	2100	2160	2220	2280	2340	2400	2460	2520	2640	2760	2880	3000	3120	3240	3360	3480	3600
125	2000	2063	2125	2188	2250	2313	2375	2438	2500	2563	2625	2750	2875	3000	3125	3250	3375	3500	3625	3750
130	2080	2145	2210	2275	2340	2405	2470	2535	2600	2665	2730	2860	2990	3120	3250	3380	3510	3640	3770	3900
135	2160	2228	2295	2363	2430	2498	2565	2633	2700	2768	2835	2970	3105	3240	3375	3510	3645	3780	3920	4050
140	2240	2310	2380	2450	2520	2590	2660	2730	2800	2870	2940	3080	3220	3360	3500	3640	3780	3920	4060	4200
145	2320	2393	2465	2538	2610	2683	2755	2828	2900	2973	3045	3190	3335	3480	3625	3770	3915	4060	4205	4350
150	2400	2475	2550	2625	2700	2775	2850	2925	3000	3075	3150	3300	3450	3600	3750	3900	4050	4200	4350	4500
155	2480	2558	2635	2713	2790	2868	2945	3023	3100	3178	3255	3410	3565	3720	3875	4030	4185	4340	4495	4650
160	2560	2640	2720	2800	2880	2960	3040	3120	3200	3280	3360	3520	3680	3840	4000	4160	4320	4480	4640	4800
165	2640	2723	2805	2888	2970	3053	3135	3218	3300	3383	3465	3630	3795	3960	4125	4290	4455	4620	4785	4950
170	2720	2805	2890	2975	3060	3145	3230	3315	3400	3485	3570	3740	3910	4080	4250	4420	4590	4760	4930	5100
175	2800	2888	2975	3063	3150	3238	3325	3413	3500	3588	3675	3850	4025	4200	4375	4550	4725	4900	5075	5250
180	2880	2970	3060	3150	3240	3330	3420	3510	3600	3690	3780	3960	4140	4320	4500	4680	4860	5040	5220	5400
185	2960	3053	3145	3238	3330	3423	3515	3608	3700	3793	3885	4070	4255	4440	4625	4810	4995	5180	5365	5550
190	3040	3135	3230	3325	3420	3515	3610	3705	3800	3895	3990	4180	4370	4560	4750	4940	5130	5320	5510	5700
195	3120	3218	3315	3413	3510	3608	3705	3803	3900	3998	4095	4290	4485	4680	4875	5070	5265	5460	5655	5850
200	3200	3300	3400	3500	3600	3700	3800	3900	4000	4100	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000

TABLE SHOWING RADIATION NECESSARY AT VARIOUS RATES

per square foot of glass or wall surface. See explanatory note bottom Page 27.

CONTINUED ON FOLLOWING PAGES

Amt.	RATE.																	
	3	3¼	3½	3¾	4	4½	5	6	7	8	10	15	17½	20	22½	25	27½	30
5	1¾	1½	1½	1½	1¼	1	1											
6	2	2	1¾	1¾	1½	1¼	1	1										
7	2¼	2¼	2	2	1¾	1½	1½	1	1									
8	2¾	2½	2¼	2	2	1¾	1½	1¼	1	1								
9	3	2¾	2½	2½	2¼	2	1¾	1½	1	1	1							
10	3¼	3	2¾	2¾	2½	2¼	2	1¾	1½	1¼	1							
11	3¾	3½	3¼	3	2¾	2½	2¼	1¾	1½	1½	1							
12	4	3¾	3½	3¼	3	2¾	2½	2	1¾	1½	1¼							
13	4¼	4	3¾	3½	3¼	3	2½	2¼	1¾	1¾	1¼							
14	4¾	4¼	4	3¾	3½	3	2¾	2¼	2	1¾	1½							
15	5	4¾	4¼	4	3¾	3¼	3	2½	2¼	2	1½	1	¾					
16	5¼	5	4½	4¼	4	3½	3¼	2¾	2¼	2	1½	1	1					
17	5¾	5¼	4¾	4½	4¼	3¾	3½	2¾	2½	2¼	1¾	1¼	1					
18	6	5½	5¼	4¾	4½	4	3½	3	2½	2¼	1¾	1¼	1					
19	6¼	6	5½	5	4¾	4¼	3¾	3¼	2¾	2½	2	1¼	1					
20	6¾	6¼	5¾	5½	5	4½	4	3¼	2¾	2½	2	1¼	1¼	1				
21	7	6½	6	5¾	5¼	4¾	4¼	3½	3	2¾	2	1½	1¼	1				
22	7¼	6¾	6¼	6	5½	5	4½	3¾	3¼	2¾	2¼	1½	1¼	1	1			
23	7¾	7	6½	6¼	5¾	5	4½	3¾	3¼	3	2¼	1½	1¼	1¼	1			
24	8	7½	6¾	6½	6	5¼	4¾	4	3½	3	2½	1½	1¼	1¼	1			
25	8¼	7¾	7¼	6¾	6¼	5½	5	4¼	3½	3¼	2½	1¾	1½	1¼	1	1		
26	8¾	8	7½	7	6½	5¾	5¼	4¼	3¾	3¼	2½	1¾	1½	1¼	1¼	1		
27	9	8¼	7¾	7¼	6¾	6	5½	4½	3¾	3½	2¾	1¾	1½	1¼	1¼	1	1	
28	9¼	8¾	8	7½	7	6¼	5½	4¾	4	3½	2¾	1¾	1½	1½	1¼	1	1	
29	9¾	9	8¼	7¾	7¼	6½	5¾	4¾	4¼	3¾	3	2	1¾	1½	1¼	1¼	1	
30	10	9¼	8½	8	7½	6¾	6	5	4¼	3¾	3	2	1¾	1½	1¼	1¼	1	1
31	10¼	9½	8¾	8¼	7¾	7	6¼	5¼	4½	4	3	2	1¾	1½	1½	1¼	1¼	1
32	10¾	10	9¼	8½	8	7	6½	5¼	4½	4	3¼	2¼	1¾	1½	1½	1¼	1¼	1
33	11	10¼	9½	8¾	8¼	7¼	6½	5½	4¾	4¼	3¼	2¼	1¾	1¾	1½	1¼	1¼	1
34	11¼	10½	9¾	9	8½	7½	6¾	5¾	4¾	4¼	3½	2¼	2	1¾	1½	1¼	1¼	1¼
35	11¾	10¾	10	9¼	8¾	7¾	7	5¾	5	4½	3½	2¼	2	1¾	1½	1½	1¼	1¼
36	12	11	10¼	9½	9	8	7¼	6	5¼	4½	3½	2½	2	1¾	1½	1½	1¼	1¼
37	12¼	11¼	10½	9¾	9¼	8¼	7½	6¼	5¼	4¾	3¾	2½	2	1¾	1¾	1½	1¼	1¼
38	12¾	11½	10¾	10	9½	8½	7½	6¼	5½	4¾	3¾	2½	2¼	2	1¾	1½	1½	1¼
39	13	12	11¼	10½	9¾	8¾	7¾	6½	5½	5	4	2½	2¼	2	1¾	1½	1½	1¼
40	13¼	12¼	11½	10¾	10	9	8	6¾	5¾	5	4	2¾	2¼	2	1¾	1½	1½	1¼
41	13¾	12½	11¾	11	10¼	9	8¼	6¾	5¾	5¼	4	2¾	2¼	2	1¾	1¾	1½	1¼
42	14	12¾	12	11¼	10½	9¼	8½	7	6	5¼	4¼	2¾	2½	2	1¾	1¾	1½	1½
43	14¼	13	12¼	11½	10¾	9½	8½	7¼	6¼	5½	4¼	2¾	2½	2¼	2	1¾	1½	1½
44	14¾	13¼	12½	11¾	11	9¾	8¾	7¼	6¼	5½	4½	3	2½	2¼	2	1¾	1½	1½
45	15	13¾	12¾	12	11¼	10	9	7½	6½	5¾	4½	3	2½	2¼	2	1¾	1¾	1½
46	15¼	14¼	13¼	12¼	11½	10¼	9¼	7¾	6½	5¾	4½	3	2¾	2¼	2	1¾	1¾	1½
47	15¾	14½	13½	12½	11¾	10½	9½	7¾	6¾	6	4¾	3¼	2¾	2¼	2	2	1¾	1½
48	16	14¾	13¾	12¾	12	10¾	9½	8	6¾	6	4¾	3¼	2¾	2½	2¼	2	1¾	1½
49	16¼	15	14	13	12¼	11	9¾	8¼	7	6¼	5	3¼	2¾	2½	2¼	2	1¾	1¾
50	16¾	15½	14¼	13½	12½	11	10	8¼	7¼	6¼	5	3¼	2¾	2½	2¼	2	1¾	1¾
51	17	15¾	14½	13¾	12¾	11¼	10¼	8½	7¼	6½	5	3½	3	2½	2¼	2	1¾	1¾
52	17¼	16	14¾	14	13	11½	10½	8¾	7½	6½	5¼	3½	3	2½	2¼	2	2	1¾
53	17¾	16¼	15¼	14¼	13¼	11¾	10½	8¾	7½	6¾	5¼	3½	3	2¾	2¼	2	2	1¾
54	18	16½	15½	14½	13½	12	10¾	9	7¾	6¾	5½	3½	3	2¾	2½	2¼	2	1¾
55	18¼	17	15¾	14¾	13¾	12¼	11	9¼	7¾	7	5½	3¾	3¼	2¾	2½	2¼	2	1¾
56	18¾	17¼	16	15	14	12½	11¼	9¼	8	7	5½	3¾	3¼	2¾	2½	2¼	2	1¾
57	19	17½	16¼	15¼	14¼	12¾	11½	9½	8¼	7¼	5¾	3¾	3¼	2¾	2½	2¼	2	2
58	19¼	17¾	16½	15½	14½	13	11½	9¾	8¼	7¼	5¾	3¾	3¼	3	2½	2¼	2	2
59	19¾	18¼	16¾	15¾	14¾	13	11¾	9¾	8½	7½	6	4	3¼	3	2½	2¼	2¼	2
60	20	18½	17¼	16	15	13¼	12	10	8½	7½	6	4	3½	3	2¾	2½	2¼	2
61	20¼	18¾	17½	16¼	15¼	13½	12¼	10¼	8¾	7¾	6	4	3½	3	2¾	2½	2¼	2
62	20¾	19	17¾	16½	15½	13¾	12½	10¼	8¾	7¾	6¼	4¼	3½	3	2¾	2½	2¼	2
63	21	19¼	18	16¾	15¾	14	12½	10½	9	8	6¼	4¼	3½	3¼	2¾	2½	2¼	2
64	21¼	19¾	18¼	17	16	14¼	12¾	10¾	9¼	8	6½	4¼	3¾	3¼	2¾	2½	2¼	2¼
65	21¾	20	18½	17¼	16¼	14½	13	10¾	9¼	8¼	6½	4¼	3¾	3¼	3	2½	2¼	2¼
66	22	20½	18¾	17¾	16½	14¾	13¼	11	9½	8¼	6½	4½	3¾	3¼	3	2¾	2½	2¼
67	22¼	20¾	19¼	18	16¾	15	13½	11¼	9½	8½	6¾	4½	3¾	3¼	3	2¾	2½	2¼
68	22¾	21	19½	18¼	17	15	13½	11¼	9¾	8½	6¾	4½	4	3½	3	2¾	2½	2¼
69	23	21¼	19¾	18½	17¼	15¼	13¾	11½	9¾	8¾	7	4½	4	3½	3	2¾	2½	2¼

TABLE SHOWING RADIATION NECESSARY AT VARIOUS RATES

per square foot of glass or wall surface. See explanatory note bottom Page 27.

CONTINUED ON FOLLOWING PAGES

Amt.	RATE.																	
	3	3¼	3½	3¾	4	4½	5	6	7	8	10	15	17½	20	22½	25	27½	30
70	23	22	20	19	18	16	14	12	10	9	7	5	4	4	3	3	3	2
71	24	22	20	19	18	16	14	12	10	9	7	5	4	4	3	3	3	2
72	24	22	21	19	18	16	14	12	10	9	7	5	4	4	3	3	3	2
73	24	23	21	20	18	16	15	12	10	9	7	5	4	4	3	3	3	2
74	25	23	21	20	19	16	15	12	11	9	7	5	4	4	3	3	3	2
75	25	23	21	20	19	17	15	13	11	9	8	5	4	4	3	3	3	3
76	25	24	22	20	19	17	15	13	11	10	8	5	4	4	3	3	3	3
77	26	24	22	21	19	17	15	13	11	10	8	5	4	4	3	3	3	3
78	26	24	22	21	20	17	16	13	11	10	8	5	4	4	3	3	3	3
79	26	24	23	21	20	18	16	13	11	10	8	5	5	4	4	3	3	3
80	27	25	23	21	20	18	16	13	11	10	8	5	5	4	4	3	3	3
81	27	25	23	22	20	18	16	14	12	10	8	5	5	4	4	3	3	3
82	27	25	24	22	21	18	16	14	12	10	8	5	5	4	4	3	3	3
83	28	26	24	22	21	18	17	14	12	10	8	6	5	4	4	3	3	3
84	28	26	24	22	21	19	17	14	12	11	8	6	5	4	4	3	3	3
85	28	26	25	23	21	19	17	14	12	11	9	6	5	4	4	3	3	3
86	29	27	25	23	22	19	17	14	12	11	9	6	5	4	4	3	3	3
87	29	27	25	23	22	19	17	15	12	11	9	6	5	4	4	3	3	3
88	29	27	25	24	22	20	18	15	13	11	9	6	5	4	4	4	3	3
89	30	28	25	24	22	20	18	15	13	11	9	6	5	4	4	4	3	3
90	30	28	26	24	23	20	18	15	13	11	9	6	5	5	4	4	3	3
91	30	28	26	24	23	20	18	15	13	11	9	6	5	5	4	4	3	3
92	31	29	26	25	23	20	18	15	13	12	9	6	5	5	4	4	3	3
93	31	29	27	25	23	21	19	16	13	12	9	6	5	5	4	4	3	3
94	31	29	27	25	24	21	19	16	13	12	9	6	5	5	4	4	3	3
95	32	30	27	26	24	21	19	16	14	12	10	6	5	5	4	4	3	3
96	32	30	27	26	24	21	19	16	14	12	10	6	5	5	4	4	3	3
97	32	30	28	26	24	22	19	16	14	12	10	6	6	5	4	4	4	3
98	33	30	28	26	25	22	20	16	14	12	10	7	6	5	4	4	4	3
99	33	31	28	27	25	22	20	17	14	12	10	7	6	5	4	4	4	3
100	33	31	29	27	25	22	20	17	14	13	10	7	6	5	4	4	4	3
110	37	34	31	30	28	24	22	19	15	14	11	7	6	6	5	4	4	4
120	40	37	34	32	30	27	24	20	17	16	12	8	7	6	5	5	4	4
130	43	40	37	35	33	29	26	22	19	17	13	9	7	7	6	5	5	4
140	47	43	40	38	35	31	28	24	20	18	14	9	8	7	6	6	5	5
150	50	46	43	40	38	33	30	25	21	19	15	10	9	8	7	6	5	5
160	53	49	46	43	40	36	32	27	23	21	16	11	9	8	7	6	6	5
170	57	52	49	46	43	38	34	29	24	22	17	11	10	9	8	7	6	6
180	60	56	51	48	45	40	36	30	26	23	18	12	10	9	8	7	7	6
190	63	59	54	51	48	42	38	32	27	24	19	13	11	10	8	8	7	6
200	67	62	57	54	50	44	40	34	29	25	20	13	11	10	9	8	7	7
210	70	65	60	56	53	47	42	35	30	26	21	14	12	11	9	8	8	7
220	73	68	63	59	55	49	44	37	31	28	22	15	13	11	10	9	8	7
230	77	71	66	61	58	51	46	39	33	29	23	15	13	12	10	9	8	8
240	80	74	69	64	60	53	48	40	34	30	24	16	14	12	11	10	9	8
250	83	77	71	67	63	56	50	42	36	31	25	17	14	13	11	10	9	8
260	87	80	74	70	65	58	52	44	37	33	26	17	15	13	12	10	10	9
270	90	83	77	72	68	60	54	45	39	34	27	18	15	14	12	11	10	9
280	93	86	80	75	70	62	56	47	40	35	28	19	16	14	12	11	10	9
290	97	89	83	77	73	64	58	48	41	36	29	19	17	15	13	12	11	10
300	100	92	86	80	75	67	60	50	43	38	30	20	17	15	13	12	11	10
310	103	95	89	83	78	69	62	52	44	39	31	21	18	16	14	12	11	10
320	107	98	91	86	80	71	64	53	46	40	32	21	18	16	14	13	12	11
330	110	101	94	88	83	73	66	55	47	41	33	22	19	17	15	13	12	11
340	113	104	97	91	85	76	68	57	49	43	34	23	19	17	15	14	12	11
350	117	108	100	94	88	78	70	58	50	44	35	23	20	18	16	14	13	12
360	120	111	103	97	90	80	72	60	51	45	36	24	21	18	16	14	13	12
370	123	114	106	99	93	82	74	62	53	46	37	25	21	19	16	15	13	12
380	127	117	109	101	95	84	76	63	54	47	38	25	22	19	17	15	14	13
390	130	120	111	104	98	87	78	65	56	49	39	26	22	20	17	16	14	13
400	133	123	114	107	100	89	80	67	57	50	40	27	23	20	18	16	15	13
410	137	126	117	110	103	91	82	68	59	51	41	27	23	21	18	16	15	14
420	140	139	120	112	105	93	84	70	60	52	42	28	24	21	19	17	15	14
430	143	132	123	115	108	96	86	72	61	53	43	29	25	22	19	17	16	14
440	147	135	126	117	110	98	88	73	63	55	44	29	25	22	20	18	16	15

TABLE SHOWING RADIATION NECESSARY AT VARIOUS RATES

per square foot of glass or wall surface. See explanatory note bottom Page 27.

OONTINUED ON FOLLOWING PAGES

Amt.	RATE.																	
	3	3¼	3½	3¾	4	4½	5	6	7	8	10	15	17½	20	22½	25	27½	30
450	150	139	129	120	113	100	90	75	64	56	45	30	26	23	20	18	16	15
460	153	142	131	123	115	102	92	77	66	58	46	31	26	23	20	18	17	15
470	157	145	134	125	118	104	94	78	67	59	47	31	27	24	21	19	17	16
480	160	148	137	128	120	107	96	80	69	60	48	32	27	24	21	19	17	16
490	163	151	140	131	123	109	98	82	70	61	49	33	28	25	22	20	18	16
500	167	154	143	133	125	111	100	83	71	63	50	33	29	25	22	20	18	17
510	170	157	146	136	128	113	102	85	73	64	51	34	29	26	23	20	18	17
520	173	160	149	139	130	116	104	87	74	65	52	35	30	26	23	21	19	17
530	177	163	151	142	133	118	106	88	76	66	53	35	30	27	24	21	19	18
540	180	167	154	145	135	120	108	90	77	68	54	36	31	27	24	22	20	18
550	183	170	157	147	138	122	110	92	79	69	55	37	31	28	24	22	20	18
560	187	173	160	150	140	124	112	93	80	70	56	37	32	28	25	22	20	19
570	190	176	163	153	143	127	114	95	81	71	57	38	33	29	25	23	21	19
580	193	179	166	156	145	129	116	97	83	73	58	39	33	29	26	23	21	19
590	197	182	169	158	148	131	118	98	84	74	59	39	34	30	26	24	21	20
600	200	185	171	160	150	133	120	100	86	75	60	40	34	30	27	24	22	20
610	203	188	174	163	153	136	122	102	87	76	61	41	35	31	27	24	22	20
620	207	191	177	166	155	138	124	103	89	78	62	41	35	31	28	25	22	21
630	210	194	180	168	158	140	126	105	90	79	63	42	36	32	28	25	23	21
640	213	197	183	171	160	142	128	107	91	80	64	43	37	32	28	26	23	21
650	217	200	186	174	163	144	130	108	93	81	65	43	37	33	29	26	24	22
660	220	203	189	177	165	147	132	110	94	83	66	44	38	33	29	26	24	22
670	223	206	192	180	168	149	134	112	96	84	67	45	38	34	30	27	24	22
680	227	209	195	182	170	151	136	113	97	85	68	45	39	34	30	27	25	23
690	230	212	198	184	173	153	138	115	99	86	69	46	39	35	31	28	25	23
700	233	215	200	187	175	156	140	117	100	88	70	47	40	35	31	28	25	23
710	237	218	203	190	178	158	142	118	101	89	71	47	41	36	32	28	26	24
720	240	221	206	192	180	160	144	120	103	90	72	48	41	36	32	29	26	24
730	243	224	209	195	183	162	146	122	104	91	73	49	42	37	32	29	26	24
740	247	227	211	198	185	164	148	123	106	93	74	49	42	37	33	30	27	25
750	250	231	214	200	188	167	150	125	107	94	75	50	43	38	33	30	27	25
760	253	234	217	203	190	169	152	127	109	95	76	51	43	38	34	30	28	25
770	257	237	220	206	193	171	154	128	110	96	77	51	44	39	34	31	28	26
780	260	240	223	209	195	173	156	130	111	98	78	52	45	39	35	31	28	26
790	263	243	226	211	198	176	158	132	113	99	79	53	45	40	35	32	29	26
800	267	246	229	214	200	178	160	133	114	100	80	53	46	40	36	32	29	27
810	270	249	231	217	203	180	162	135	116	101	81	54	46	41	36	32	29	27
820	273	252	234	220	205	182	164	137	117	103	82	55	47	41	36	33	30	27
830	277	255	237	223	208	184	166	138	119	104	83	55	47	42	37	33	30	28
840	280	258	240	225	210	187	168	140	120	105	84	56	48	42	37	34	30	28
850	283	262	243	227	213	189	170	142	121	106	85	57	49	43	38	34	31	28
860	287	265	246	230	215	191	172	143	123	108	86	57	49	43	38	34	31	29
870	290	268	249	232	218	193	174	145	124	109	87	58	50	44	39	35	32	29
880	293	271	251	235	220	196	176	147	126	110	88	59	50	44	39	35	32	29
890	297	274	254	238	223	198	178	148	127	111	89	59	51	45	40	36	32	30
900	300	277	257	240	225	200	180	150	129	113	90	60	51	45	40	36	33	30
910	303	280	260	243	228	202	182	152	130	114	91	61	52	46	40	36	33	30
920	307	283	263	246	230	204	184	153	131	115	92	61	53	46	41	37	33	31
930	310	286	266	249	233	207	186	155	133	116	93	62	53	47	41	37	34	31
940	313	289	269	251	235	209	188	157	134	118	94	63	54	47	42	38	34	31
950	317	293	271	254	238	211	190	158	136	119	95	63	54	48	42	38	34	32
960	320	296	274	257	240	213	192	160	137	120	96	64	55	48	43	38	35	32
970	323	299	277	260	243	216	194	162	139	121	97	65	55	49	43	39	35	32
980	327	302	280	262	245	218	196	163	140	123	98	65	56	49	44	39	36	33
990	330	305	283	265	248	220	198	165	141	124	99	66	57	50	44	40	36	33
1000	333	308	286	268	250	202	200	167	143	125	100	67	57	50	44	40	36	33
1020	340	314	291	272	255	227	204	170	146	128	102	68	58	51	45	41	37	34
1040	347	320	297	277	260	231	208	173	149	130	104	69	59	52	46	42	38	35
1060	353	326	303	283	265	236	212	177	152	133	106	71	61	53	47	42	39	35
1080	360	332	309	288	270	240	216	180	154	135	108	72	62	54	48	43	39	36
1100	367	338	314	293	275	244	220	183	157	138	110	73	63	55	49	44	40	37
1120	373	344	320	299	280	249	224	187	160	140	112	75	64	56	50	45	41	37
1140	380	351	326	304	285	253	228	190	163	143	114	76	65	57	51	46	42	38
1160	387	357	331	309	290	258	232	193	166	145	116	77	66	58	52	46	42	39
1180	393	363	337	315	295	292	236	197	169	148	118	79	67	59	52	47	43	39

TABLE SHOWING RADIATION NECESSARY AT VARIOUS RATES

per square foot of glass or wall surface. See explanatory note bottom Page 27.

CONTINUED ON FOLLOWING PAGES

Amt.	RATE.																	
	3	3¼	3½	3¾	4	4½	5	6	7	8	10	15	17½	20	22½	25	27½	30
1200	400	370	343	320	300	267	240	200	171	150	120	80	69	60	53	48	44	40
1220	407	376	349	326	305	271	244	203	174	153	122	81	70	61	54	49	44	41
1240	413	381	354	330	310	276	248	207	177	155	124	83	71	62	55	50	45	41
1260	420	388	360	336	315	280	252	210	180	158	126	84	72	63	56	50	46	42
1280	427	394	366	342	320	284	256	213	183	160	128	85	73	64	57	51	47	43
1300	433	400	371	347	325	289	260	217	186	163	130	87	74	65	58	52	47	43
1320	440	406	377	352	330	293	264	220	189	165	132	88	75	66	59	53	48	44
1340	447	412	383	357	335	298	268	223	191	168	134	89	77	67	60	54	49	45
1360	453	418	389	363	340	302	272	227	194	170	136	91	78	68	60	54	49	45
1380	460	424	394	368	345	307	276	230	197	173	138	92	79	69	61	55	50	46
1400	467	430	400	374	350	311	280	233	200	175	140	93	80	70	62	56	51	47
1420	473	436	406	379	355	316	284	237	203	178	142	95	81	71	63	57	52	47
1440	480	442	411	384	360	320	288	240	206	180	144	96	82	72	64	58	52	48
1460	487	448	417	389	365	324	292	243	209	183	146	97	83	73	65	58	53	49
1480	493	455	423	394	370	329	296	247	211	185	148	99	85	74	66	59	54	49
1500	500	461	429	400	375	333	300	250	214	188	150	100	86	75	67	60	55	50
1520	507	468	434	406	380	338	304	253	217	190	152	101	87	76	68	61	55	51
1540	513	474	440	411	385	342	308	257	220	193	154	103	88	77	68	62	56	51
1560	520	480	446	416	390	347	312	260	223	195	156	104	89	78	69	62	57	52
1580	527	486	451	421	395	351	316	263	226	198	158	105	90	79	70	63	57	53
1600	533	492	457	427	400	356	320	267	229	200	160	107	91	80	71	64	58	53
1620	540	498	463	432	405	360	324	270	231	203	162	108	93	81	72	65	59	54
1640	547	504	469	437	410	364	328	273	234	205	164	109	94	82	73	66	60	55
1660	554	510	474	443	415	369	332	277	237	208	166	111	95	83	74	66	60	55
1680	560	516	480	448	420	373	336	280	240	210	168	112	96	84	75	67	61	56
1700	567	522	486	453	425	378	340	283	243	213	170	113	97	85	76	68	62	57
1720	573	529	491	459	430	382	344	287	246	215	172	115	98	86	76	69	63	57
1740	580	535	497	464	435	387	348	290	249	218	174	116	99	87	77	70	63	58
1760	587	541	503	470	440	391	352	293	251	220	176	117	101	88	78	70	64	59
1780	593	547	509	475	445	396	356	297	254	223	178	119	102	89	79	71	65	59
1800	600	553	514	480	450	400	360	300	257	225	180	120	103	90	80	72	65	60
1820	607	559	520	486	455	404	364	303	260	228	182	121	104	91	81	73	66	61
1840	613	565	526	491	460	409	368	307	263	230	184	123	105	92	82	74	67	61
1860	620	572	531	496	465	413	372	310	266	233	186	124	106	93	83	74	68	62
1880	627	578	537	502	470	418	376	313	269	235	188	125	107	94	84	75	68	63
1900	633	584	543	507	475	422	380	317	271	238	190	127	109	95	84	76	69	63
1920	640	590	549	512	480	427	384	320	274	240	192	128	110	96	85	77	70	64
1940	647	596	554	518	485	431	388	323	277	243	194	129	111	97	86	78	71	65
1960	653	603	560	523	490	436	392	327	280	245	196	131	112	98	87	78	71	65
1980	660	609	566	528	495	440	396	330	283	248	198	132	113	99	88	79	72	66
2000	667	615	571	534	500	444	400	333	286	250	200	133	114	100	89	80	73	67
2020	673	621	577	539	505	449	404	337	289	253	202	135	115	101	90	81	73	67
2040	680	628	583	544	510	453	408	340	291	255	204	136	117	102	91	82	74	68
2060	687	634	589	550	515	458	412	343	294	258	206	137	118	103	92	82	75	69
2080	693	640	594	555	520	462	416	347	297	260	208	139	119	104	92	83	76	69
2100	700	646	600	560	525	467	420	350	300	263	210	140	120	105	93	84	76	70
2120	707	652	606	565	530	471	424	353	303	265	212	141	121	106	94	85	77	71
2140	713	658	611	571	535	476	428	357	306	268	214	143	122	107	95	86	78	71
2160	720	664	617	576	540	480	432	360	309	270	216	144	123	108	96	86	79	72
2180	727	670	623	582	545	484	436	363	311	273	218	145	125	109	97	87	79	73
2200	733	676	629	587	550	489	440	367	314	275	220	147	126	110	98	88	80	73
2220	740	682	634	593	555	493	444	370	317	278	222	148	127	111	99	89	81	74
2240	747	688	640	598	560	498	448	373	320	280	224	149	128	112	100	90	81	75
2260	753	695	646	603	565	502	452	377	323	283	226	151	129	113	100	90	82	75
2280	760	701	651	608	570	507	456	380	326	285	228	152	130	114	101	91	83	76
2300	767	708	657	613	575	511	460	383	329	288	230	153	131	115	102	92	84	77
2320	773	714	663	619	580	516	464	387	331	290	232	155	133	116	103	93	84	77
2340	780	720	669	624	585	520	468	390	334	293	234	156	134	117	104	94	85	78
2360	787	726	674	630	590	524	472	393	337	295	236	157	135	118	105	94	86	79
2380	793	732	680	635	595	529	476	397	340	298	238	159	136	119	106	95	87	79
2400	800	738	686	640	600	533	480	400	343	300	240	160	137	120	107	96	87	80
2420	807	744	691	646	605	538	484	403	346	303	242	161	138	121	108	97	88	81
2440	813	750	697	651	610	542	488	407	349	305	244	163	139	122	108	98	89	81
2460	820	758	703	656	615	547	492	410	351	308	246	164	141	123	109	98	89	82
2480	827	764	709	662	620	551	496	413	354	310	248	165	142	124	110	99	90	83

TABLE SHOWING RADIATION NECESSARY AT VARIOUS RATES

per square foot of glass or wall surface. See explanatory note bottom Page 27.

CONTINUED ON FOLLOWING PAGES

Amt.	RATE.																	
	3	3¼	3½	3¾	4	4½	5	6	7	8	10	15	17½	20	22½	25	27½	30
2500	833	770	714	666	625	556	500	417	357	313	250	167	143	125	111	100	91	83
2520	840	776	720	672	630	560	504	420	360	315	252	168	144	126	112	101	92	84
2540	847	782	726	678	635	564	508	423	363	318	254	169	145	127	113	102	92	85
2560	853	788	731	684	640	569	512	427	366	320	256	171	146	128	114	102	93	85
2580	860	794	737	689	645	573	516	430	369	323	258	172	147	129	115	103	94	86
2600	867	800	743	694	650	578	520	433	371	325	260	173	149	130	116	104	95	87
2620	873	806	749	699	655	582	524	437	374	328	262	175	150	131	116	105	95	87
2640	880	812	754	704	660	587	528	440	377	330	264	176	151	132	117	106	96	88
2660	887	818	760	709	665	591	532	443	380	333	266	177	152	133	118	106	97	89
2680	893	824	766	715	670	596	536	447	383	335	268	179	153	134	119	107	97	89
2700	900	832	771	720	675	600	540	450	386	338	270	180	154	135	120	108	98	90
2720	907	838	777	725	680	604	544	453	389	340	272	181	155	136	121	109	99	91
2740	913	844	783	731	685	609	548	457	391	343	274	183	157	137	122	110	100	91
2760	920	850	789	736	690	613	552	460	394	345	276	184	158	138	123	110	100	92
2780	927	856	794	742	695	618	556	463	397	348	278	185	159	139	124	111	101	93
2800	933	862	800	747	700	622	560	467	400	350	280	187	160	140	124	112	102	93
2820	940	868	806	752	705	627	564	470	403	353	282	188	161	141	125	113	103	94
2840	947	874	811	757	710	631	568	473	406	355	284	189	162	142	126	114	103	95
2860	953	880	817	763	715	636	572	477	409	358	286	191	163	143	127	114	104	95
2880	960	886	823	768	720	640	576	480	411	360	288	192	165	144	128	115	105	96
2900	967	893	829	773	725	644	580	483	414	363	290	193	166	145	129	116	105	97
2920	973	899	834	778	730	649	584	487	417	365	292	195	167	146	130	117	106	97
2940	980	905	840	784	735	653	588	490	420	368	294	196	168	147	131	118	107	98
2960	987	911	846	789	740	658	592	493	423	370	296	197	169	148	132	118	108	99
2980	993	917	851	795	745	662	596	497	426	373	298	199	170	149	132	119	108	99
3000	1000	923	857	800	750	667	600	500	429	375	300	200	171	150	133	120	109	100
3050	1017	939	871	813	763	678	610	508	436	381	305	203	174	153	136	122	111	102
3100	1033	954	886	826	775	689	620	517	443	388	310	207	177	155	138	124	113	103
3150	1050	970	900	840	788	700	630	525	450	394	315	210	180	158	140	126	115	105
3200	1067	985	914	853	800	711	640	533	457	400	320	213	183	160	142	128	116	107
3250	1083	1000	929	867	813	722	650	542	464	406	325	217	186	163	144	130	118	108
3300	1100	1015	943	880	825	733	660	550	471	412	330	220	189	165	147	132	120	110
3350	1117	1030	957	893	838	744	670	558	479	419	335	223	191	168	149	134	122	112
3400	1133	1045	971	907	850	756	680	567	486	425	340	227	194	170	151	136	124	113
3450	1150	1060	986	920	863	767	690	575	493	431	345	230	197	173	153	138	125	115
3500	1167	1076	1000	933	875	778	700	583	500	438	350	233	200	175	156	140	127	117
3550	1183	1092	1014	947	888	789	710	592	507	444	355	237	203	178	158	142	129	118
3600	1200	1107	1029	960	900	800	720	600	514	450	360	240	206	180	160	144	131	120
3650	1217	1123	1043	973	913	811	730	608	521	456	365	243	209	183	162	146	133	122
3700	1233	1138	1057	987	925	822	740	617	529	462	370	247	211	185	164	148	135	123
3750	1250	1153	1071	1000	938	833	750	625	536	469	375	250	214	188	167	150	136	125
3800	1267	1170	1086	1013	950	844	760	633	543	475	380	253	217	190	169	152	138	127
3850	1283	1185	1100	1026	963	856	770	642	550	481	385	257	220	193	171	154	140	128
3900	1300	1200	1114	1040	975	867	780	650	557	488	390	260	223	195	173	156	142	130
3950	1317	1215	1129	1053	988	878	790	658	564	494	395	263	226	198	176	158	144	132
4000	1333	1231	1143	1067	1000	889	890	667	571	500	400	267	229	200	178	160	145	133
4050	1350	1246	1157	1080	1013	900	810	675	579	506	405	270	231	203	180	162	147	135
4100	1367	1261	1171	1093	1025	911	820	683	586	512	410	273	234	205	182	164	149	137
4150	1383	1277	1186	1107	1038	922	830	692	593	519	415	277	237	208	184	166	151	138
4200	1400	1292	1200	1120	1050	933	840	700	600	525	420	280	240	210	187	168	153	140
4250	1417	1308	1214	1133	1063	944	850	708	607	531	425	283	243	213	189	170	155	142
4300	1433	1323	1229	1146	1075	956	860	717	614	538	430	287	246	215	191	172	156	143
4350	1450	1338	1243	1160	1088	967	870	725	621	544	435	290	249	218	193	174	158	145
4400	1467	1353	1257	1173	1100	978	880	733	629	550	440	293	251	220	196	176	160	147
4450	1483	1370	1271	1186	1113	989	890	742	636	556	445	297	254	223	198	178	162	148
4500	1500	1385	1286	1200	1125	1000	900	750	643	562	450	300	257	225	200	180	164	150
4550	1517	1400	1300	1213	1138	1011	910	758	650	569	455	303	260	228	202	182	165	152
4600	1533	1415	1314	1227	1150	1022	920	767	657	575	460	307	263	230	204	184	167	153
4650	1550	1430	1329	1240	1163	1033	930	775	664	581	465	310	266	233	207	186	169	155
4700	1567	1445	1343	1253	1175	1044	940	783	671	588	470	313	269	235	209	188	171	157
4750	1583	1461	1357	1267	1188	1056	950	792	679	594	475	317	271	238	211	190	173	158
4800	1600	1476	1371	1280	1200	1067	960	800	686	600	480	320	274	240	213	192	175	160
4850	1617	1492	1386	1293	1213	1078	970	808	693	606	485	323	277	243	216	194	176	162
4900	1633	1508	1400	1307	1225	1089	980	817	700	612	490	327	280	245	218	196	178	163
4950	1650	1523	1414	1320	1238	1100	990	825	707	619	495	330	283	248	220	198	180	165

TABLE SHOWING RADIATION NECESSARY AT VARIOUS RATES

per square foot of glass or wall surface. See explanatory note bottom Page 27.

Amt.	RATE.																
	3	3¼	3½	4	4½	5	6	7	8	10	15	17½	20	22½	25	27½	30
5000	1667	1540	1429	1250	1111	1000	833	714	625	500	333	286	250	222	200	182	167
5050	1683	1554	1443	1263	1122	1010	842	721	631	505	337	289	253	224	202	184	168
5100	1700	1570	1457	1275	1133	1020	850	729	638	510	340	291	255	227	204	185	170
5150	1717	1585	1471	1288	1144	1030	858	736	644	515	343	294	258	229	206	187	172
5200	1733	1600	1486	1300	1156	1040	867	743	650	520	347	297	260	231	208	189	173
5250	1750	1615	1500	1313	1167	1050	875	750	656	525	350	300	263	233	210	191	175
5300	1767	1630	1514	1325	1178	1060	883	757	663	530	353	303	265	236	212	193	177
5350	1783	1645	1529	1338	1189	1070	892	764	669	535	357	306	268	238	214	195	178
5400	1800	1661	1543	1350	1200	1080	900	771	675	540	360	309	270	240	216	196	180
5450	1817	1677	1557	1363	1211	1090	908	779	681	545	363	311	273	242	218	198	182
5500	1833	1693	1571	1375	1222	1100	917	786	688	550	367	314	275	244	220	200	183
5550	1850	1708	1586	1388	1233	1110	925	793	694	555	370	317	278	247	222	202	185
5600	1867	1724	1600	1400	1244	1120	933	800	700	560	373	320	280	249	224	204	187
5650	1883	1739	1614	1413	1256	1130	942	807	706	565	377	323	283	251	226	205	188
5700	1900	1755	1629	1425	1267	1140	950	814	713	570	380	326	285	253	228	207	190
5750	1917	1770	1643	1438	1278	1150	958	821	719	575	383	329	288	256	230	209	192
5800	1933	1785	1657	1450	1289	1160	967	829	725	580	387	331	290	258	232	211	193
5850	1950	1800	1671	1463	1300	1170	975	836	731	585	390	334	293	260	234	213	195
5900	1967	1815	1686	1475	1311	1180	983	843	738	590	393	337	295	262	236	215	197
5950	1983	1830	1700	1488	1322	1190	992	850	744	595	397	340	298	264	238	216	198
6000	2000	1846	1714	1500	1333	1200	1000	857	750	600	400	343	300	267	240	218	200
6050	2017	1861	1729	1513	1344	1210	1008	864	756	605	403	346	303	269	242	220	202
6100	2033	1876	1743	1525	1356	1220	1017	871	763	610	407	349	305	271	244	222	203
6150	2050	1892	1757	1538	1367	1230	1025	879	769	615	410	351	308	273	246	224	205
6200	2067	1908	1771	1550	1378	1240	1033	886	775	620	413	354	310	276	248	225	207
6250	2083	1924	1786	1563	1389	1250	1042	893	781	625	417	357	313	278	250	227	208
6300	2100	1939	1800	1575	1400	1260	1050	900	788	630	420	360	315	280	252	229	210
6350	2117	1954	1814	1588	1411	1270	1058	907	794	635	423	363	318	282	254	231	212
6400	2133	1970	1829	1600	1422	1280	1067	914	800	640	427	366	320	284	256	233	213
6450	2150	1985	1843	1613	1433	1290	1075	921	806	645	430	369	323	287	258	235	215
6500	2167	2000	1857	1625	1444	1300	1083	929	813	650	433	371	325	289	260	236	217
6550	2183	2015	1871	1638	1456	1310	1092	936	819	655	437	374	328	291	262	238	218
6600	2200	2030	1886	1650	1467	1320	1100	943	825	660	440	377	330	293	264	240	220
6650	2217	2045	1900	1663	1478	1330	1108	950	831	665	443	380	333	296	266	242	222
6700	2233	2061	1914	1675	1489	1340	1117	957	838	670	447	383	335	298	268	244	223
6750	2250	2077	1929	1688	1500	1350	1125	964	844	675	450	386	338	300	270	245	225
6800	2267	2092	1943	1700	1511	1360	1133	971	850	680	453	389	340	302	272	247	227
6850	2283	2108	1957	1713	1522	1370	1142	979	856	685	457	391	343	304	274	249	228
6900	2300	2123	1971	1725	1533	1380	1150	986	863	690	460	394	345	307	276	251	230
6950	2317	2139	1986	1738	1544	1390	1158	993	869	695	463	397	348	309	278	253	232
7000	2333	2154	2000	1750	1556	1400	1167	1000	875	700	467	400	350	311	280	255	233
8000	2667	2460	2286	2000	1778	1600	1334	1143	1000	800	533	457	400	356	320	291	267
9000	3000	2770	2571	2250	2000	1800	1500	1286	1125	900	600	514	450	400	360	327	300
10000	3333	3075	2857	2500	2222	2000	1667	1429	1250	1000	667	571	500	444	400	364	333
20000	6666	6150	5714	5000	4444	4000	3333	2857	2500	2000	1333	1143	1000	889	800	727	667
30000	10000	9225	8571	7500	6667	6000	5000	4286	3750	3000	2000	1714	1500	1333	1200	1091	1000
40000	13333	12300	11429	10000	8889	8000	6667	5714	5000	4000	2667	2286	2000	1778	1600	1455	1333
50000	16666	15375	14286	12500	11111	10000	8333	7143	6250	5000	3333	2857	2500	2222	2000	1818	1667
60000	20000	18450	17143	15000	13333	12000	10000	8571	7500	6000	4000	3429	3000	2667	2400	2182	2000
70000	23333	21525	20000	17500	15556	14000	11667	10000	8750	7000	4667	4000	3500	3111	2800	2545	2333
80000	26666	24600	22857	20000	17778	16000	13333	11429	10000	8000	5333	4571	4000	3556	3200	2909	2667
90000	30000	27675	25714	22500	20000	18000	15000	12857	11250	9000	6000	5143	4500	4000	3600	3273	3000
100000	33333	30750	28571	25000	22222	20000	16667	14286	12500	10000	6667	5714	5000	4444	4000	3636	3333
200000	66666	61500	57143	50000	44444	40000	33333	28571	25000	20000	13333	11429	10000	8889	8000	7273	6667
300000	100000	92250	85714	75000	66667	60000	50000	42857	37500	30000	20000	17143	15000	13333	12000	10909	10000

EXPLANATION TO TABLE ABOVE.

The column of figures at the left of each page represents either square feet of glass surface, square feet of wall surface, or cubic feet.

The row of figures at the top are the rates.

The column of figures under each rate is the product of the column of figures on the left divided by that rate.

To ascertain the amount of radiation necessary to heat any given number of square feet of glass, wall surface, or cubic feet, turn to the number in the left-hand column (under "Amt.") representing the amount to be warmed; look opposite this, and under the desired rate you will find the amount of radiation required at that rate.

CIRCUMFERENCES AND AREAS OF CIRCLES.

Diam.	Circ.	Area.	Diam.	Circ.	Area.	Diam.	Circ.	Area.	Diam.	Circ.	Area.
1/32	.0981	.00076	7½	23.56	44.178	16	50.26	201.06	24½	76.96	471.43
1/16	.1963	.00306		23.95	45.663		50.65	204.21		77.36	476.25
1/8	.3926	.01227	7¾	24.34	47.173	16¼	51.05	207.39	24¾	77.75	481 10
3/16	.5890	.02761		24.74	48.707		51.44	210.59		78.14	485.97
1/4	.7854	.04908	8	25.13	50.265	16½	51.83	213.82	25	78.54	490.87
5/16	.9817	.07669		25.52	51.848		52.22	217.07		78.93	495.79
3/8	1.178	.1104	8¼	25.91	53.456	16¾	52.62	220.35	25¼	79.32	500.74
7/16	1.374	.1503		26.31	55.088		53.01	223.65		79.71	505.71
1/2	1.570	.1963	8½	26.70	56.745	17	53.40	226.98	25½	80.10	510.70
9/16	1.767	.2485		27.09	58.426		53.79	230.33		80.50	515.72
5/8	1.963	.3097	8¾	27.48	60.132	17¼	54.19	233.70	25¾	80.89	520.70
11/16	2.159	.3712		27.88	61.862		54.58	237.10		81.28	525.83
3/4	2.356	.4417	9	28.27	63.617	17½	54.97	240.52	26	81.68	530.93
13/16	2.552	.5184		28.66	65.396		55.37	243.97		82.07	536.04
7/8	2.748	.6013	9¼	29.05	67.200	17¾	55.76	247.45	26¼	82.46	541.18
15/16	2.945	.6902		29.45	69.029		56.16	250.94		82.85	546.35
1	3.141	.7854	9½	29.84	70.882	18	56.54	254.46	26½	83.25	551.54
	3.534	.9940		30.23	72.759		56.94	258.01		83.64	556.76
1¼	3.927	1.227	9¾	30.63	74.662	18¼	57.33	261.58	26¾	84.03	562.00
	4.319	1.484		31.02	76.588		57.72	265.18		84.43	567.26
1½	4.712	1.767	10	31.41	78.539	18½	58.11	268.80	27	84.82	572.55
	5.105	2.073		31.80	80.515		58.51	272.44		85.21	577.87
1¾	5.497	2.405	10¼	32.20	82.516	18¾	58.90	276.11	27¼	85.60	583.20
	5.890	2.761		32.59	84.540		59.29	279.81		86.00	588.57
2	6.283	3.141	10½	32.98	86.590	19	59.69	283.52	27½	86.39	593.95
	6.675	3.546		33.37	88.664		60.08	287.27		86.78	599.37
2¼	7.068	3.976	10¾	33.77	90.762	19¼	60.47	291.03	27¾	87.17	604.80
	7.461	4.430		34.16	92.885		60.86	294.83		87.57	610.26
2½	7.854	4.908	11	34.55	95.033	19½	61.26	298.64	28	87.96	615.75
	8.246	5.411		34.95	97.205		61.65	302.48		88.35	621.26
2¾	8.639	5.939	11¼	35.34	99.402	19¾	62.04	306.35	28¼	88.75	626.79
	9.032	6.491		35.73	101.62		62.43	310.24		89.14	632.35
3	9.424	7.068	11½	36.12	103.86	20	62.83	314.16	28½	89.53	637 94
	9.817	7.669		36.52	106.13		63.22	318.09		89.92	643.54
3¼	10.21	8.295	11¾	36.91	108.43	20¼	63.61	322.06	28¾	90.32	649.18
	10.60	8.946		37.30	110.75		64.01	326.05		90.71	654.83
3½	10.99	9.621	12	37.69	113.09	20½	64.40	330.06	29	91.10	660.52
	11.38	10.320		38.09	115.46		64.79	334.10		91.49	666.22
3¾	11.78	11.044	12¼	38.48	117.85	20¾	65.18	338.16	29¼	91.89	671.95
	12.17	11.793		38.87	120.27		65.58	342.25		92.28	677.71
4	12.56	12.566	12½	39.27	122.71	21	65.97	346.36	29½	92.67	683.49
	12.95	13.364		39.66	125.18		66.36	350.49		93.06	689.29
4¼	13.35	14.186	12¾	40.05	127.67	21¼	66.75	354.65	29¾	93.46	695.12
	13.74	15.033		40.44	130.19		67.15	358.84		93.85	700.98
4½	14.13	15.904	13	40.84	132.73	21½	67.54	363.05	30	94.24	706.86
	14.52	16.800		41.23	135.29		67.93	367.28		94.64	712.76
4¾	14.92	17.720	13¼	41.62	137.88	21¾	68.32	371.54	30¼	95.03	718.69
	15.31	18.665		42.01	140.50		68.72	375.82		95.42	724.64
5	15.70	19.635	13½	42.41	143.13	22	69.11	380.13	30½	95.81	730.61
	16.10	20.629		42.80	145.80		69.50	384.46		96.21	736.61
5¼	16.49	21.647	13¾	43.19	148.48	22¼	69.90	388.82	30¾	96.60	742.64
	16.88	22.690		43.58	151.20		70.29	393.20		96.99	748.69
5½	17.27	23.758	14	43.98	153.93	22½	70.68	397.60	31	97.38	754.76
	17.67	24.850		44.37	156.69		71.07	402.03		97.78	760.86
5¾	18.06	25.967	14¼	44.76	159.48	22¾	71.47	406.49	31¼	98.17	766.99
	18.45	27.108		45.16	162.29		71.86	410.97		98.56	773.14
6	18.84	28.274	14½	45.55	165.13	23	72.25	415.47	31½	98.96	779.31
	19.24	29.464		45.94	167.98		72.64	420.00		99.35	785.51
6¼	19.63	30.679	14¾	46.33	170.87	23¼	73.04	424.55	31¾	99.74	791.73
	20.02	31.919		46.73	173.78		73.43	429.13		100.1	797.97
6½	20.42	33.183	15	47.12	176.71	23½	73.82	433.73	32	100.5	804.24
	20.81	34.471		47.51	179.67		74.21	438.30		100.9	810.54
6¾	21.20	35.784	15¼	47.90	182.72	23¾	74.61	443.01	32¼	101.3	816.86
	21.57	37.122		48.30	185.66		75.00	447.69		101.7	823.21
7	21.99	38.484	15½	48.69	188.69	24	75.39	452.39	32½	102.1	829.57
	22.38	39.871		49.08	191.74		75.79	457.11		102.4	835.97
7¼	22.77	41.282	15¾	49.48	194.82	24¼	76.18	461.86	32¾	102.8	842.39
	23.16	42.718		49.87	197.73		76.57	466.63		103.2	848.83

CIRCUMFERENCES AND AREAS OF CIRCLES.

CONTINUED.

Diam.	Circ.	Area.	Diam.	Circ.	Area.	Diam.	Circ.	Area.	Diam.	Circ.	Area.
33	103.6	855.30	41½	130.3	1352.6	50	157.0	1963.5	58½	183.7	2687.8
	104.0	861.79		130.7	1360.8		157.4	1973.3		184.1	2699.3
33¼	104.4	868.30	41¾	131.1	1369.0	50¼	157.8	1983.1	58¾	184.5	2710.8
	104.8	874.88		131.5	1377.2		158.2	1993.0		184.9	2722.4
33½	105.2	881.41	42	131.9	1385.4	50½	158.6	2002.9	59	185.3	2733.9
	105.6	888.00		132.3	1393.7		159.0	2012.8		185.7	2745.5
33¾	106.0	894.61	42¼	132.7	1401.9	50¾	159.4	2022.8	59¼	186.1	2757.1
	106.4	901.25		133.1	1410.2		159.8	2032.8		186.5	2768.8
34	106.8	907.92	42½	133.5	1418.6	51	160.2	2042.8	59½	186.9	2780.5
	107.2	914.61		133.9	1426.9		160.6	2052.8		187.3	2792.2
34¼	107.5	921.32	42¾	134.3	1435.3	51¼	161.0	2062.9	59¾	187.7	2803.9
	107.9	928.06		134.6	1443.7		161.3	2072.9		188.1	2815.6
34½	108.3	934.82	43	135.0	1452.2	51½	161.7	2083.0	60	188.4	2827.4
	108.7	941.60		135.4	1460.6		162.1	2093.2		188.8	2839.2
34¾	109.1	948.41	43¼	135.8	1469.1	51¾	162.5	2103.3	60¼	189.2	2851.0
	109.5	955.25		136.2	1477.6		162.9	2113.5		189.6	2862.8
35	109.9	962.11	43½	136.6	1486.1	52	163.3	2123.7	60½	190.0	2874.7
	110.3	968.99		137.0	1494.7		163.7	2133.9		190.4	2886.6
35¼	110.7	975.90	43¾	137.4	1503.3	52¼	164.1	2144.1	60¾	190.8	2898.5
	111.1	982.84		137.8	1511.9		164.5	2154.4		191.2	2910.5
35½	111.5	989.80	44	138.2	1520.5	52½	164.9	2164.7	61	191.6	2922.4
	111.9	996.78		138.6	1529.1		165.3	2175.0		192.0	2934.4
35¾	112.3	1003.7	44¼	139.0	1537.8	52¾	165.7	2185.4	61¼	192.4	2946.4
	112.7	1010.8		139.4	1546.5		166.1	2195.7		192.8	2958.5
36	113.0	1017.8	44½	139.8	1555.2	53	166.5	2206.1	61½	193.2	2970.5
	113.4	1024.9		140.1	1564.0		166.8	2216.6		193.6	2982.6
36¼	113.8	1032.0	44¾	140.5	1572.8	53¼	167.2	2227.0	61¾	193.9	2994.7
	114.2	1039.1		140.9	1581.6		167.6	2237.5		194.3	3006.9
36½	114.6	1049.3	45	141.3	1590.4	53½	168.0	2248.0	62.	194.7	3019.0
	115.0	1053.5		141.7	1599.2		168.4	2258.5		195.1	3031.2
36¾	115.4	1060.7	45¼	142.1	1608.1	53¾	168.8	2269.0	62¼	195.5	3043.4
	115.8	1067.9		142.5	1617.0		169.2	2279.6		195.9	3055.7
37	116.2	1075.2	45½	142.9	1625.9	54	169.6	2290.2	62½	196.3	3067.9
	116.6	1082.4		143.3	1634.9		170.0	2300.8		196.7	3080.2
37¼	117.0	1089.7	45¾	143.7	1643.8	54¼	170.4	2311.4	62¾	197.1	3092.5
	117.4	1097.1		144.1	1652.8		170.8	2322.1		197.5	3104.8
37½	117.8	1104.4	46	144.5	1661.9	54½	171.2	2332.8	63	197.9	3117.2
	118.2	1111.8		144.9	1670.9		171.6	2343.5		198.3	3129.6
37¾	118.6	1119.2	46¼	145.2	1680.0	54¾	172.0	2354.2	63¼	198.7	3142.0
	118.9	1126.6		145.6	1689.1		172.3	2365.0		199.0	3144.4
38	119.3	1134.1	46½	146.0	1698.2	55	172.7	2375.8	63½	199.4	3166.9
	119.7	1141.5		146.4	1707.3		173.1	2386.6		199.8	3179.4
38¼	120.1	1149.0	46¾	146.8	1716.5	55¼	173.5	2397.4	63¾	200.2	3191.9
	120.5	1156.6		147.2	1725.7		173.9	2408.3		200.6	3204.4
38½	120.9	1164.1	47	147.6	1734.9	55½	174.3	2419.2	64	201.0	3216.9
	121.3	1171.7		148.0	1744.1		174.7	2430.1		201.4	3229.5
38¾	121.7	1179.3	47¼	148.4	1753.4	55¾	175.1	2441.0	64¼	201.8	3242.1
	122.1	1186.9		148.8	1762.7		175.5	2452.0		202.2	3254.8
39	122.5	1194.5	47½	149.2	1772.0	56	175.9	2463.0	64½	202.6	3267.4
	122.9	1202.2		149.6	1781.3		176.3	2474.0		203.0	3280.1
39¼	123.3	1209.9	47¾	150.0	1790.7	56¼	176.7	2485.0	64¾	203.4	3292.8
	123.7	1217.6		150.4	1800.1		177.1	2496.1		203.8	3305.5
39½	124.0	1225.4	48	150.7	1809.5	56½	177.5	2507.1	65	204.2	3318.3
	124.4	1233.1		151.1	1818.9		177.8	2518.2		204.5	3331.0
39¾	124.8	1240.9	48¼	151.5	1828.4	56¾	178.2	2529.4	65¼	204.9	3343.8
	125.2	1248.7		151.9	1837.9		178.6	2540.5		205.3	3356.7
40	125.6	1256.6	48½	152.3	1847.4	57	179.0	2551.7	65½	205.7	3369.5
	126.0	1264.5		152.7	1856.9		179.4	2562.9		206.1	3382.4
40¼	126.4	1272.3	48¾	153.1	1866.5	57¼	179.8	2574.1	65¾	206.5	3395.3
	126.8	1280.3		153.5	1876.1		180.2	2585.4		206.9	3408.2
40½	127.2	1288.2	49	153.9	1885.7	57½	180.6	2596.7	66	207.3	3421.2
	127.6	1291.2		154.3	1895.3		181.0	2608.0		207.7	3434.1
40¾	128.0	1304.2	49¼	154.7	1905.0	57¾	181.4	2619.3	66¼	208.1	3447.1
	128.4	1312.2		155.1	1914.7		181.8	2630.7		208.5	3460.1
41	128.8	1320.2	49½	155.5	1924.4	58	182.2	2642.0	66½	208.9	3473.2
	129.1	1328.3		155.9	1934.1		182.6	2653.4		209.3	3486.3
41¼	129.5	1336.4	49¾	156.2	1943.9	58¼	182.9	2664.9	66¾	209.7	3499.3
	129.9	1344.5		156.6	1953.6		183.3	2676.3		210.0	3512.5

CIRCUMFERENCES AND AREAS OF CIRCLES.

CONCLUDED.

Diam.	Circ.	Area.	Diam.	Circ.	Area.	Diam.	Circ.	Area.	Diam.	Circ.	Area.
67	210.4	3525.6	75½	237.1	4476.9	84	263.8	5541.7	92½	290.5	6720.0
	210.9	3538.8		237.5	4491.8		264.2	5558.2		290.9	6738.2
67¼	211.2	3552.0	75¾	237.9	4506.6	84¼	264.6	5574.8	92¾	291.3	6756.4
	211.6	3565.2		238.3	4521.5		265.0	5591.3		291.7	6776.4
67½	212.0	3578.4	76	238.7	4536.4	84½	265.4	5607.9	93	292.1	6792.9
	212.4	3591.7		239.1	4551.4		265.8	5624.5		292.5	6811.1
67¾	212.8	3605.0	76¼	239.5	4566.3	84¾	266.2	5641.1	93¼	292.9	6829.4
	213.2	3618.3		239.9	4581.3		266.6	5657.8		293.3	6847.8
68	213.6	3631.6	76½	240.3	4596.3	85	267.0	5674.5	93½	293.7	6866.1
	214.0	3645.0		240.7	4611.3		267.4	5691.2		294.1	6884.5
68¼	214.4	3658.4	76¾	241.1	4626.4	85¼	267.8	5707.9	93¾	294.5	6902.9
	214.8	3671.8		241.5	4641.5		268.2	5724.6		294.9	6921.3
68½	215.1	3685.2	77	241.9	4656.6	85½	268.6	5741.4	94	295.3	6939.7
	215.5	3698.7		242.2	4671.7		268.9	5758.2		295.7	6958.2
68¾	215.9	3712.2	77¼	242.6	4686.9	85¾	269.3	5775.0	94¼	296.0	6976.7
	216.3	3725.7		243.0	4702.1		269.7	5791.9		296.4	6995.2
69	216.7	3739.2	77½	243.4	4717.3	86	270.1	5808.8	94½	296.8	7013.8
	217.1	3752.8		243.8	4732.5		270.5	5825.7		297.2	7032.3
69¼	217.5	3766.4	77¾	244.2	4747.7	86¼	270.9	5842.6	94¾	297.6	7050.9
	217.9	3780.0		244.6	4763.0		271.3	5859.5		298.0	7069.5
69½	218.3	3793.6	78	245.0	4778.3	86½	271.7	5876.5	95	298.4	7088.2
	218.7	3807.3		245.4	4793.7		272.1	5893.5		298.8	7106.9
69¾	219.1	3821.0	78¼	245.8	4809.0	86¾	272.5	5910.5	95¼	299.2	7125.5
	219.5	3834.7		246.2	4824.4		272.9	5927.6		299.6	7144.3
70	219.9	3848.4	78½	246.6	4839.8	87	273.3	5944.6	95½	300.0	7163.0
	220.3	3862.2		247.0	4855.2		273.7	5961.7		300.4	7181.8
70¼	220.6	3875.9	78¾	247.4	4870.7	87¼	274.1	5978.9	95¾	300.8	7200.5
	221.0	3889.8		247.7	4886.1		274.4	5996.0		301.2	7219.4
70½	221.4	3903.6	79	248.1	4901.6	87½	274.8	6013.2	96	301.5	7238.2
	221.8	3917.4		248.5	4917.2		275.2	6030.4		301.9	7257.1
70¾	222.2	3931.3	79¼	248.9	4932.7	87¾	275.6	6047.6	96¼	302.3	7275.9
	222.6	3945.2		249.3	4948.3		276.0	6064.8		302.7	7294.9
71	223.0	3959.2	79½	249.7	4963.9	88	276.4	6082.1	96½	303.1	7313.8
	223.4	3973.1		250.1	4979.5		276.8	6099.4		303.5	7332.8
71¼	223.8	3987.1	79¾	250.5	4995.1	88¼	277.2	6116.7	96¾	303.9	7341.7
	224.2	4001.1		250.9	5010.8		277.6	6134.0		304.3	7370.7
71½	224.6	4015.1	80	251.3	5026.5	88½	278.0	6151.4	97	304.7	7389.8
	225.0	4029.2		251.7	5042.2		278.4	6168.8		305.1	7408.8
71¾	225.4	4043.2	80¼	252.1	5058.0	88¾	278.8	6186.2	97¼	305.5	7427.9
	225.8	4067.3		252.5	5073.7		279.2	6203.6		305.9	7447.0
72	226.1	4071.5	80½	252.8	5089.5	89	279.6	6221.1	97½	306.3	7466.2
	226.5	4085.6		253.2	5105.4		279.9	6238.6		306.6	7485.3
72¼	226.9	4099.8	80¾	253.6	5121.2	89¼	280.3	6256.1	97¾	307.0	7504.5
	227.3	4114.0		254.0	5137.1		280.7	6273.6		307.4	7523.7
72½	227.7	4128.2	81	254.4	5153.0	89½	281.1	6291.2	98	307.8	7542.9
	228.1	4142.5		254.8	5168.9		281.5	6308.8		308.2	7562.2
72¾	228.5	4156.7	81¼	255.2	5184.8	89¾	281.9	6326.4	98¼	308.6	7581.5
	228.9	4171.0		255.6	5200.8		282.3	6344.0		309.0	7600.8
73	229.3	4185.3	81½	256.0	5216.8	90	282.7	6361.7	98½	309.4	7620.1
	229.7	4199.7		256.4	5232.8		283.1	6379.4		309.8	7639.4
73¼	230.1	4214.1	81¾	256.8	5248.8	90¼	283.5	6397.1	98¾	310.2	7658.8
	230.5	4228.5		257.2	5264.9		283.9	6414.8		310.6	7678.2
73½	230.9	4242.9	82	257.6	5281.0	90½	284.3	6432.6	99	311.0	7697.7
	231.3	4257.3		258.0	5297.1		284.7	6450.4		311.4	7717.1
73¾	231.6	4271.8	82¼	258.3	5313.2	90¾	285.1	6468.2	99¼	311.8	7736.6
	232.0	4286.3		258.7	5329.4		285.4	6486.0		312.1	7756.1
74	232.4	4300.8	82½	259.1	5345.6	91	285.8	6503.8	99½	312.5	7775.6
	232.8	4315.3		259.5	5361.8		286.2	6521.7		312.9	7795.2
74¼	233.2	4329.9	82¾	259.9	5378.0	91¼	286.6	6539.6	99¾	313.3	7814.7
	233.6	4344.5		260.3	5494.3		287.0	6557.6		313.7	7834.3
74½	234.0	4359.1	83	260.7	5410.6	91½	287.4	6575.5	100	314.1	7853.9
	234.4	4373.8		261.1	5426.9		287.8	6593.5		314.5	7874.0
74¾	234.8	4388.4	83¼	261.5	5443.2	91¾	288.2	6611.5	100¼	314.9	7893.3
	235.2	4403.1		261.9	5459.6		288.6	6629.5		315.3	7913.1
75	235.6	4417.8	83½	262.3	5476.0	92	289.0	6647.6	100½	315.7	7932.7
	236.0	4432.6		262.7	5492.4		289.4	6665.7		316.0	7942.4
75¼	236.4	4447.3	83¾	263.1	5508.8	92¼	289.8	6683.8	100¾	316.4	7972.2
	236.7	4462.1		263.5	5525.3		290.2	6701.9		316.8	7991.9

SQUARE FEET OF DIRECT STEAM OR HOT WATER RADIATION SUPPLIED IN GREENHOUSES BY MAIN SUPPLY PIPES, TWO-PIPE SYSTEM, LOW PRESSURE STEAM HEATING AND OPEN TANK HOT WATER HEATING *

STEAM.			HOT WATER.	
Size of Flow Pipe.	Square feet of Radiation Supplied.	Size of Return Pipe.	Size of Pipe.	Square feet of Radiation supplied by Flow and Return Pipe.
1	35	½	1	40
1¼	80	¾	1¼	90
1½	140	1	1½	130
2	300	1	2	250
2½	460	1¼	2½	350
3	670	1¼	3	500
3½	920	1½	3½	700
4	1200	1½	4	900
4½	1650	1½	4½	1150
5	1875	2	5	1400
6	2700	2	6	2100
7	3700	2½	7	3000
8	4800	2½	8	4000
9	6100	3	9	5000
10	7500	3	10	6000
11	9100	3½	11	7400
12	11000	3½	12	9000

* See page 32 carrying capacity of pipes.

EQUALIZATION OF PIPE AREAS.

Pipe Sizes.	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10
½	1.	1.7	2.9	4.9	6.6	11.	15.7	24.	32.4	41.8	52.4	65.6	94.8	127.	164.	205.	259.
¾		1.	1.6	2.6	3.8	6.3	9.	13.8	18.5	23.9	30.	37.5	54.2	72.6	94.	117.5	148.
1			1.	1.7	2.4	3.9	5.5	8.6	11.4	14.7	18.5	23.1	33.5	44.8	58.	72.6	91.4
1¼				1.	1.4	2.3	3.2	5.	6.6	8.5	10.6	13.3	19.3	25.9	33.4	41.9	52.6
1½					1.	1.6	2.4	3.6	4.9	6.2	7.8	9.8	14.1	19.	24.5	31.4	38.7
2						1.	1.4	2.2	3.	3.8	4.7	5.9	8.6	11.5	14.9	18.6	23.5
2½							1.	1.6	2.1	2.7	3.3	4.2	6.	8.1	10.4	13.1	16.5
3								1.	1.4	1.7	2.1	2.7	3.9	5.2	6.8	8.5	10.6
3½									1.	1.3	1.6	2.2	2.9	3.9	5.6	6.3	8.
4										1.	1.2	1.5	2.3	3.	3.9	4.9	6.2
4½											1.	1.2	1.8	2.4	3.1	3.9	4.9
5												1.	1.4	1.9	2.5	3.1	3.9
6													1.	1.3	1.7	2.2	2.7
7														1.	1.3	1.6	2.3
8															1.	1.2	1.6
9																1.	1.2
10																	1.

NOTE. — For transverse areas of pipes — external, internal and metal, see page 37.

RELATIVE CAPACITIES OF PIPES FOR CONVEYING OR DISCHARGING LIQUIDS AND CASES.

Diam.	¾	1	1¼	1½	2	2½	3	3½	4	5	6	7	8	9	10	12	Diam.
¾	1	2.05	3.57	5.66	11.61	20.40	31.98										¾
1		1.00	1.74	2.75	5.66	9.87	15.57	23.00	32.00	56.00	88.00	129.00	181.00	243.00	316.00	498.00	1
1¼			1.00	1.57	3.21	5.66	8.95	13.21	18.39	32.12	50.67	74.00	104.00	139.00	181.00	286.00	1¼
1½				1.00	2.05	3.57	5.66	8.39	11.61	20.28	32.18	47.04	66.00	88.00	115.00	182.00	1½
2					1.00	1:74	2.75	4.06	5.66	9.87	15.57	22.90	31.98	42.93	55.86	88.13	2
2½						1.00	1.57	2.32	3.24	5.66	8.93	13.13	18.33	24.61	32.02	50.52	2½
3							1.00	1.47	2.05	3.57	5.66	8.39	11.61	15.57	20.28	32.18	3
3½								1.00	1.39	2.43	3.83	5.66	7.91	10.57	14.10	21.69	3½
4									1.00	1.74	2.75	4.06	5.66	7.59	9.87	15.57	4
5										1.00	1.57	2.32	3.24	4.24	5.66	8.93	5
6											1.00	1.47	2.05	2.75	3.57	5.66	6
7												1.00	1.39	1.88	2.43	3.83	7
8													1.00	1.33	1.74	2.75	8
9														1.00	1.20	2.05	9
10															1.00	1.57	10

The capacity of a pipe is in inverse proportion to the square root of its length.
Doubling the diameter of a pipe increases its capacity 5.66 times.

Equalization of Pipe Radiation.

Values, or quantities, can be represented by space, or distance, and, if the divisions be in exact proportion, each to the other, diagrams can be made from which results are read off at a glance, and by having parts of the diagram movable, many examples can be quickly performed without mental calculations.

The column of figures on the scale in centre of diagram on this page represents square feet of surface subdivided into tenths. The figures on the upright lines represent the number of pipes, each one foot long, required to make the amount of radiation shown on the scale opposite said figures.

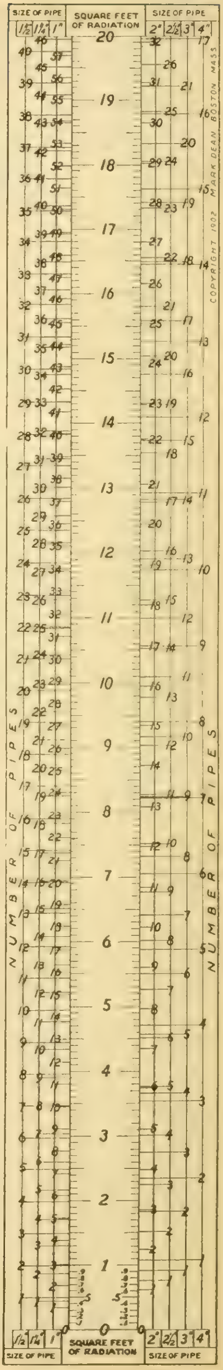
When the number of pipes of two or more sizes appear opposite the same amount on scale, their radiation is equal, or is proportionally equal as they come proportionally opposite the same amount of radiation.

The diagram hereon was made principally for determining the number of pipes in a greenhouse, and as this can be accomplished easier with a moving scale, I send a separate diagram with each book, so that the scale on same can be cut out and the two sides fastened to a thin piece of wood so as to allow the scale to be moved between them.

HOW TO USE THE SCALE.

If pipes are all to be of one size, look on line representing size of pipe to be used, exactly opposite the amount of radiation required, the number found will be the number of pipes required. In all cases where the amount of radiation required comes between two numbers use the next larger number of pipes.

If pipes are to be of different sizes, move the scale downward a distance equal to the radiation of all the large pipes, and opposite the total amount of radiation to be used will be found the number of small pipes necessary. Thus if a house 100 ft. long requires 4.8 sq. ft. per lineal ft. in which you wish to use one, 2 in. flow pipe, one 2½ in. flow pipe and 1¼ in. returns but do not know how many,— Move the scale downward equal to the radiation in one 2 in. pipe — See Figure 1. Again move it downward, but this time equal to the radiation in a 2½ in. pipe — See Figure 2. Without moving the scale again look opposite 4.8 and you will find eight, the required number of 1¼ in. pipes.



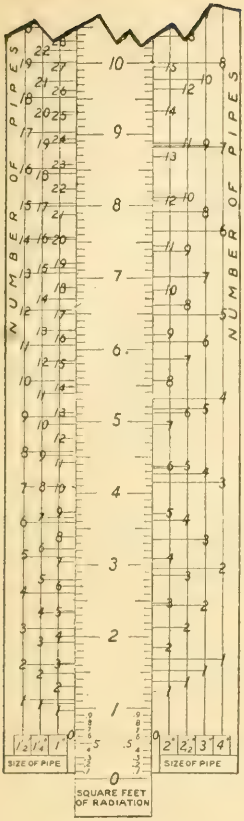


Fig. 1.

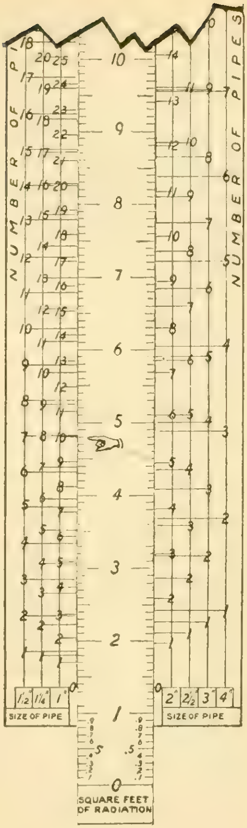


Fig. 2.

Maximum lengths for pipes in coils for low pressure steam and open tank hot water heating.*

SIZE OF PIPE	STEAM		HOT WATER
	TWO PIPE SYSTEM	SINGLE PIPE SYSTEM	
1 inch	100 feet	60 feet	120 feet.
$1\frac{1}{4}$ "	170 "	110 "	200 "
$1\frac{1}{2}$ "	275 "	160 "	250 "
2 "	475 "	250 "	400 "
$2\frac{1}{2}$ "	625 "	300 "	600 "

* Under favorable conditions, good pitch in pipes, etc., greater lengths for steam can be used by carrying more than 5 lbs. pressure, but it is not advisable.

GUIDE POSTS.

The suggestions given below are not intended to cover the ground of pipe fitting, but are simply to guard against errors which are common and which can be avoided.

BOILER ROOM AND CHIMNEY.

Geographical conditions often determine the location of boiler room, but when equally convenient its position should be such as to prevent the chimney from casting shadow on the houses.

Good chimney draft is imperative to the success of the boiler (boilers do not make draft). The diameter of the chimney can be obtained from the boiler makers and generally from their catalogues. The height should be sufficient to prevent surrounding houses, trees or other obstacles from interfering.

MAIN SUPPLY PIPES.

If you want a good working job, put in large mains. I have known many cases where small steam mains have caused sufficient water to leave the boiler to seriously damage same.

RADIATING SURFACES.

Never depend upon forcing your heating system in severe weather. Put in sufficient radiation to easily do the work in extreme weather and you will save the extra cost of piping in fuel in a short time.

LOCATION OF RADIATION.

To secure a uniform temperature throughout the house, the radiation should be distributed as evenly as possible. Bunching the radiation is liable to cause drafts, detrimental to the best development of plant life.

SIDE COILS vs. FLAT COILS.

Water will circulate more evenly through coils laid flat (∘∘∘) than it will through upright coils $\left(\begin{smallmatrix}\circ\\\circ\\\circ\end{smallmatrix}\right)$; the tendency of hot water in upright coils is to pass through the top pipes only, especially is this true if the supply pipe is too small, therefore, plan larger branches to supply vertical coils.

GRADING THE PIPES.

Special care should be exercised in grading the pipes so as to give an even pitch, because pockets in the pipes interfere with the circulation of either steam or hot water. An upward bend followed by a downward bend in a line of hot water pipes forms an air pocket. A downward bend followed by an upward bend in a line of steam pipes forms a water pocket.

EXPANSION AND CONTRACTION.

The force exerted in cast or wrought iron pipes when heated is great enough to move a boiler or push the end out of a Greenhouse (I have known both to happen) ; therefore, support all pipes on expansion hangers and allow at least 1¼ inch for expansion for each one hundred lineal feet of pipe. "Expansion joints" are to be avoided whenever possible on account of repairs. "Swing joints" which answer the same purpose, are preferable, whenever they can be used.

BRANCH PIPES.

Branch pipes from steam main should be taken from top, side or midway between top and side, preferably the latter.

Branches from hot water supply pipe should be taken off at side or at an angle of 45° above the side.

HOT WATER PIPES.

Flow and return pipes should always be the same size. Never abutt two return pipes but bring them together through a twin elbow, Y, or one into the side of the other.

TWINNING STEAM BOILERS.

Whenever steam boilers are connected two or more in a battery there should be, in addition to the regular flow and return pipes, an independent connection above the water line, running from boiler to boiler and an independent connection below water line near bottom of boiler, for equalizing the water line. The steam connection for equalizing the pressure should be about ¼ the capacity of the main steam pipe and the water connection should be about ¼ to ½ the capacity of the main return pipe.

REAMING PIPES.

In cutting pipe there is often a burr left on the inside caused by the pressure of the cutter. It reduces the capacity materially, therefore to get the best results, the ends of the pipes should be carefully reamed out before placing them in position.

VALVES.

It is important in either steam or hot water heating to have full size, frictionless openings, therefore, as far as possible avoid the use of globe valves by using either angle or gate valves.

Angle valves are cheaper and can often be arranged to displace an elbow, thus saving a fitting and an extra cut in the pipe.

AIR VALVES.

Steam coils or radiators should each be supplied with an air valve placed low down on the return end in a place least liable to catch water from condensation. The end of each return from steam main should be supplied with an automatic air valve placed as high above water line as convenient.

All hot water mains, branches, coils or radiators should have an air valve at highest point except when the arrangement of pipes is such that the air will pass out through them.

EXPANSION TANK.

The expansion tank should have capacity equal to 5% of the total contents of boiler, radiators, pipes and fittings. It should be located at a point above the highest pipes or radiators and should be connected to boiler without any valve between.

If, instead of using an expansion tank, connection is made to a large supply tank it will be necessary to have a shut-off-valve in the expansion pipe to close in case of a leak. Whenever this is done, connect to the expansion pipe on boiler side of the shut-off-valve and extend a pipe back to and turned over top of the large tank so that if the valve is accidently left closed the water from expansion can escape and thus prevent damaging the apparatus.

COVERING PIPES.

Flow and return pipes should be covered except when actually needed for radiating surface. Covering the pipes not only saves fuel, but insures quicker and better service throughout the entire system.

AUTOMATIC WATER FEEDER.

The cost of an Automatic Water Feeder is so small and the advantages so great that they should be applied to every steam or hot water plant that is to be left over night without an attendant. I have known of many cases where a slight leak running several hours drained the boiler after which it was spoiled by fire, causing hundreds of dollars worth of damage, whereas, an Automatic Water Feeder would have kept water running in and prevented any damage.

AUTOMATIC LOW WATER ALARM.

Boilers that are to be left over night without attention, should be provided with an Automatic Alarm. Accidents do happen, therefore, it is but the part of wisdom to prevent as much damage as possible.

UNDERGROUND PIPES.

Never allow heating pipes to come in contact with the earth because the moisture in the soil forms an excellent conductor of heat and in the course of a season will rob you of considerable fuel. Carefully cover and box all underground pipes. A thick coat of tar should be applied to the external surface of the box, and if there is liable to be standing water in the ground the box should be water-tight.

RIGHT AND LEFT COUPLINGS.

For pipes 2-inch and smaller, right and left couplings are preferable to unions with packing and are more reliable, if properly put together. To make a tight joint, screw the coupling onto one of the threads, mark it, back it off, counting the number of turns to unscrew it, then screw it onto the other thread, mark that end, unscrew it as before, counting the revolutions. Generally it will screw onto one thread more than the other. Screw the coupling onto the long thread the number of turns it took in excess of the short thread, then get the pipes in perfect alignment, press them together, turn the coupling and it will make up tight. If the coupling screws onto both threads the same number of turns, start it on both at the same time.

ATTENTION TO SMALL THINGS.

In many Greenhouse plants insufficient attention is given to caring for the details of the heating apparatus. Heating surfaces of the boilers should be kept clean, the water in the boilers should be changed, valves kept packed, etc. Dirt, either on the outside or inside of the boiler decreases the absorption of heat, requires more coal and renders the boiler more susceptible to rust. Steam or water escaping from the valve stems cuts them out and requires more fuel. It requires but very little attention at the proper time to keep these things in good condition and owners should pay strict attention thereto.

Several times during each heating season the safety valve should be lifted to make sure that it is in proper working order.

Special attention should be given to the grate bars, because if the ashes are allowed to accumulate up under them so as to shut off the cold air and there is a good fire above, they will melt down in a very short time, whereas, if the ash pit is always kept clean they will last many years.

WROUGHT IRON WELDED STEAM,

Adopted April 2, 1900. PRICE LIST AND TABLE

Kind of Pipe.	Size of Pipe.	PRICE PER FOOT.						Square Feet of Radiation in One Lineal Foot of Pipe.	Square Feet of Radiation Per Cubic Foot of Contents in Pipes.	Actual Diameter in Inches.		Thickness in Inches.
		BLACK. 1¼ In. and Smaller. Per Cent Discount. .... 1½ Inch and Larger. Per Cent Discount.			GALVANIZED. 1¼ In. and Smaller. Per Cent Discount. .... 1½ In. and Larger. Per Cent Discount.					External.	Internal.	
		List.	Cost.	Price.	List.	Cost.	Price.					
Butt Welded.	⅛	$0.05½	....	....	$0.05½	....	....	.106	276.878	.405	.270	.068
	¼	.05½	....	....	.05½	....	....	.142	196.428	.540	.364	.088
	⅜	.05½	....	....	.05½	....	....	.176	132.211	.675	.494	.091
	½	.8½	....	....	.08½	....	....	.220	103.928	.840	.623	.109
	¾	.11½	....	....	.11½	....	....	.275	74.250	1.050	.824	.113
	1	.16½	....	....	.16½	....	....	.346	57.747	1.315	1.048	.134
	1¼	.22½	....	....	.22½	....	....	.434	40.772	1.660	1.380	.140
Lap Welded.	1½	.27	....	....	.27	....	....	.494	34.906	1.900	1.611	.145
	2	.36	....	....	.36	....	....	.622	28.306	2.375	2.067	.154
	2½	.57½	....	....	.57½	....	....	.753	22.665	2.875	2.468	.204
	3	.75½	....	....	.75½	....	....	.916	17.862	3.500	3.067	.217
	3½	.95	....	....	.95	....	....	1.055	15.371	4.000	3.548	.226
	4	1.08	....	....	1.08	....	....	1.175	13.289	4.500	4.026	.237
	4½	1.30	....	....	1.30	....	....	1.309	11.807	5.000	4.508	.246
	5	1.45	....	....	1.45	....	....	1.455	10.476	5.563	5.045	.259
	6	1.88	....	....	1.88	....	....	1.739	8.660	6.625	6.065	.280
	7	2.35	....	....	2.35	....	....	1.996	7.425	7.625	7.023	.301
	8	2.82	....	....	2.82	....	....	2.257	6.500	8.625	7.982	.322
	9	3.40	....	....	....	....	....	2.519	5.768	9.625	8.937	.344
	10	4.25	....	....	....	....	....	2.816	5.125	10.750	10.018	.366
	11	4.75	....	....	....	....	....	3.140	4.571	12.000	11.250	.375
	12	5.20	....	....	....	....	....	3.344	4.246	12.750	12.000	.375
	13	....	....	....	....	....	....	3.663	3.809	14.000	13.250	.375
	14	....	....	....	....	....	....	3.921	5.540	15.000	14.250	.375
	15	....	....	....	....	....	....	4.182	3.295	16.000	15.250	.375

Nov., 1901. CONDENSED LIST PRICE OF FITTINGS FOR WROUGHT-IRON PIPE.

Diameter of Pipe	⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6
Elbows—M. I.	04	4	6	10	15	22	25	35	50	80	1.50	2.25	3.00	.....	.....	.....
Tees “	7	7	8	11	15	25	30	45	60	1.05	1.70	2.50	3.40	.....	.....	.....
Crosses “	..	8	10	12	20	30	40	60	1.00	1.75	3.00	3.25	5.25	.....	.....	.....
Elbows—Cast Iron	..	05	5	6	8	10½	16	20	28	50	75	1.05	1.20	1.75	2.00	2.75
“ R. & L. & R'd C. I.	..	6	6	7	9	12	18	23	32	60	85	1.20	1.40	2.00	2.30	3.15
“ 45° Mall. Iron	..	..	10	12	18	26	36	54	82	1.60	2.10	3.00	4.50	.....	.....	.....
“ 45° Cast Iron	..	6	6	7	10	12	19	24	34	60	90	1.25	1.45	2.20	2.50	3.45
Tees “	..	08	08	9	12	15	23	29	41	73	1.10	1.50	1.75	2.55	3.00	4.00
“ Reduc'g “	..	..	9	10	14	17	27	33	47	83	1.25	1.75	2.00	2.95	3.50	4.60
Crosses “	..	..	15	16	22	27	42	53	75	1.30	2.00	2.70	3.15	4.60	5.50	7.25
“ Reduc'g “	..	..	..	18	25	30	46	60	83	1.45	2.20	3.00	3.50	5.10	6.00	8.00
Bushings	..	4	4	4	5	6	7	9	14	21	30	40	50	75	93	1.25
Caps, Cast Iron	..	..	..	..	..	....	..	..	26	40	54	75	87	1.05	1.20	1.55
“ Mall. Iron	..	3	4	5	8	12	16	24	32	45	85	1.50	2.00	.....	.....	.....
Couplings, W. I.—R. H.	5	5	6	7	10	13	17	21	28	40	60	80	1.00	1.50	1.65	2.40
“ W. I. R. & L.	7	7	8	11	15	20	25	30	50	85	1.20	1.60	2.00	.....	.....	.....
“ M. I., R. H.	..	3	4	7	10	14	20	25	35	50	75	.....	.....	.....	.....	.....
“ M. I., R. & L.	..	4	5	8	12	16	25	36	52	75	1.00	.....	.....	.....	.....	.....
Locknuts, Cast Iron	..	..	..	..	..	....	..	..	25	27	34	47	64	85	90	1.30
“ Mall. Iron	..	2	3	4	5	7	9	11	18	40	50	.....	.....	.....	.....	.....
Long Screws	..	30	35	40	55	75	1.00	1.30	1.70	2.70	3.70	5.40	6.60	.....	.....	.....
Nipples, Close and Shld	4	4	4	5	6	8	11	13	18	39	48	75	85	1.25	1.55	1.85
“ “ R. & L.	5	5	5	7	8	11	15	18	24	52	65	1.00	1.15	.....	.....	.....
“ Long	6	6	6	7	9	13	17	20	27	59	72	1.05	1.20	1.70	2.45	2.90
“ “ R. & L.	8	8	8	10	12	18	23	27	36	79	96	1.40	1.60	.....	.....	.....

GAS, AND WATER PIPE.

OF STANDARD DIMENSIONS.

Circumference.		Transverse Areas.			Length of Pipe per Sq. Foot of		Length of Pipe Containing One Cubic Foot.	Nominal Weight Per Foot.	Number of Threads Per Inch of Screw.	Size of Hole to Drill for Tap.
External.	Internal.	External.	Internal.	Metal.	External Surface.	Internal Surface.				
Inches.	Inches.	Sq. Ins.	Sq. Ins.	Sq. Ins.	Feet.	Feet.	Feet.	Lbs.		
1 272	848	129	0573	0717	9 44	14 15	2513	241	27	21-64
1 696	1 144	229	1041	1249	7 075	10 49	1383 3	42	18	29-64
2 121	1 552	358	1917	1663	5 657	7 73	751 2	559	18	19-32
2 639	1 957	554	3048	2492	4 547	6 13	472 4	837	14	23-32
3 299	2 589	866	5333	3327	3 637	4 635	270	1 115	14	15-16
4 131	3 292	1 358	8626	4954	2 904	3 645	166 9	1 668	11½	1 3-16
5 215	4 335	2 164	1 496	668	2 301	2 768	96 25	2 244	11½	1 15-32
5 969	5 061	2 835	2 038	797	2 01	2 371	70 66	2 678	11½	1 23-32
7 461	6 494	4 443	3 356	1 074	1 608	1 848	42 91	3 609	11½	2 3-16
9 032	7 753	6 492	4 784	1 703	1 328	1 547	30 1	5 739	8	2 ⅝
10 996	9 636	9 621	7 388	2 243	1 091	1 245	19 5	7 536	8	3 ¼
12 566	11 146	12 566	9 887	2 679	955	1 077	14 57	9 001	8	3 ¾
14 137	12 648	15 904	12 73	3 174	849	949	11 31	10 665	8	4 ¼
15 708	14 162	19 635	15 961	3 674	764	848	9 02	12 34	8	4 ¾
17 477	15 849	24 306	19 99	4 316	687	757	7 2	14 502	8	5 5-16
20 813	19 054	34 472	28 888	5 584	577	63	4 98	18 762	8	6 5-16
23 955	22 063	45 664	38 738	6 926	501	544	3 72	23 271	8	7 ⅜
27 096	25 076	58 426	50 04	8 386	443	478	2 88	28 177	8	8 ⅜
30 238	28 076	72 76	62 73	10 03	397	427	2 29	33 701	8	9 19-32
33 772	31 477	90 763	78 839	11 924	355	382	1 82	40 065	8	10 13-16
37 699	35 343	113 098	89 402	13 696	318	339	1 456	45 95	8	
40 055	37 7	127 677	113 098	14 579	299	319	1 27	48 985	8	
43 982	41 626	153 938	137 887	16 051	273	288	1 04	53 921	8	
47 124	44 768	176 715	159 485	17 23	255	268	903	57 893	8	
50 265	47 909	201 062	182 655	18 407	239	259	788	61 77	8	

FITTINGS FOR WROUGHT-IRON PIPE—CONTINUED.

Diameter of Pipe............	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6
Return Bends, C. P., C. I...	..	..	18	20	22	28	40	57	1.20	1.70	....	....	....	....	....
“ “ C.P.C.I.R. & L.	..	..	21	23	26	33	46	66	1.40	1.95	....	....	....	....	....
“ “ C. P., M. I.	..	..	13	25	35	50	75	1.00	....	....	....	....	....	....	....
“ “ C. I., Open	..	..	24	26	30	40	55	80	1.35	2.20	....	....	....	....	....
“ “ C. I., op. R. & L.	..	..	28	30	35	46	64	92	1.55	2.50	....	....	....	....	....
“ “ C. I. op. B. O.	..	..	..	38	42	60	80	1.15	2.00	3.00	....	....	....	....	....
“ “ C.P.C.I.pitched	..	..	..	..	26	33	..	....	....	....	....	....	....	....	....
“ “ C.P.C.I. R. & L.	..	..	..	..	26	33	..	....	....	....	...	....	....	....	....
Short Shank Hooks, C. I. ..	..	..	..	08	9	10	15	22	35	45	....	....	....	....	....
Side Outlet Elbows, C. I....	..	..	18	24	30	48	60	84	1.50	2.25	3.15	3.60	5.25	6.00	8.25
“ “ Tee, C. I.	..	..	27	36	45	70	90	1.25	2.25	3.25	4.50	5.25	7.65	9.00	12.00
Tinned Straps, S. Iron......	1	1	1	1½	2	3	4	5	....	....	..	....	....	....	....
Unions — M. I................	18	20	22	27	33	46	58	75	1.55	2.10	3.65	4.35	....	....	....
Union Flanges..............	..	37	40	46	52	64	78	1.00	1.25	1.50	1.80	2.10	2.70	3.15	3.95
W. I. Hooks	1	1	1½	2	3	4	5	6	....	....	....	....	....	....	....
W. I. Service Bends........	..	..	28	37	56	77	1.12	1.65	....	....	....	....	....	....	....
Y Branches, C. I............	..	18	20	28	34	54	66	94	1.66	2.50	3.50	4.00	5.90	7.00	9.20
“ Reducing......	..	..	23	33	40	62	76	1.08	1.90	2.90	4.00	4.60	6.80	8.00	10.60
Offsets, to set off 4 in.	..	..	..	45	70	1.00	1.20	1.80	3.00	4.00	5.00	6.00	....	8.00	10.00
“ “ “ 6 “	..	..	..	67	105	1.50	1.80	2.70	4.50	6.00	7.50	9.00	....	12.00	15.00
“ “ “ 8 “	..	..	..	90	140	2.00	2.40	3.60	6.00	8.00	10.00	12.00	....	16.00	20.00
Plugs, Cast Iron	2	2	2	3	4	5	7	10	18	25	38	42	65	88	1.20
“ Socket........	..	..	4	6	8	9	11	15	....	....	....	1.30	....	2.70	....
Reducing Coupling, C. I. ...	..	..	..	..	..	..	..	43	60	80	1.00	1.35	1.85	2.00	2.70
“ “ M. I....	3	3	5	10	16	20	28	45	70	1.00	1.50	1.85	....	....	....
“ “ Offset..	..	..	..	50	55	60	70	1.00	1.50	2.40	3.00	4.00	...	6.00	8.00

Right and Left and Left Hand Fittings not specified above will be charged 15 per cent. more than Right Hand Fittings.

CAPACITIES OF BOILERS.

FOR HOT WATER HEATING APPARATUS.

And capable of maintaining the temperature of the water in the Apparatus at 180° Fahr. over night without attention. (G. E. DIXON.)

Boiler Surface in Square Feet.	Total Direct Radiation in Square Feet.	Direct Radiation Per Sq Foot of Boiler Surface.
20	110	5.50
30	181	6.03
40	257	6.42
50	338	6.76
60	425	7.08
70	512	7.46
80	603	7.54
90	695	7.72
100	792	7.92
120	991	8.26
140	1198	8.56
159	1400	8.80
199	1842	9.25
225	2142	9.52
279	2788	9.99
323	3332	10.31
372	3976	10.68
453	5065	11.18
517	5938	11.48

FOR LOW PRESSURE STEAM HEATING APPARATUS.

And capable of maintaining steam over night without attention. (G. E. DIXON.)

Boiler Surface in Square feet.	Total Direct Radiation in Square Feet.	Direct Radiation Per Square Foot of boiler surface
40	168	4.20
50	218	4.36
60	272	4.53
80	384	4.80
100	504	5.04
120	626	5.21
140	752	5.37
152	830	5.46
172	962	5.60
194	1114	5.74
211	1232	5.84
252	1522	6.04
292	1816	6.21
295	1840	6.23
347	2240	6.45
399	2642	6.62
421	2820	6.69
482	3321	6.89
541	3818	7.05

The quantities of radiation in the above table are exclusive of all piping.

One square foot of Indirect requires the same boiler capacity as 1½ square feet of Direct Radiation. From John Davis Company's catalogue, by permission.

TEMPERATURE OF STEAM, PRESSURE OF WATER AND CAPACITY OF TANKS.

Degree of Heat Per Lb. Pressure of Steam.		Pressure per Sq. in. per ft. Head of Water.		TANK CAPACITY.	
Pounds Pressure.	Degrees.	Feet Head.	Equals Pressure per sq. in.	Diameter.	Gallons Per Foot of Depth.
0	212	1	.43	2 Feet Inches	23.5
1	215	2	.87	2 " 6 "	36.7
2	219	3	1.30	3 "	52.9
3	222	4	1.73	3 " 6 "	72.0
4	224	5	2.16	4 "	94.0
5	227	10	4.33	4 " 6 "	119.0
6	230	15	6.49	5 "	146.9
7	232	20	8.66	5 " 6 "	177.7
8	235	25	10.82	6 "	221.5
9	238	30	12.99	6 " 6 "	248.2
10	240	35	15.16	7 "	287.9
15	250	40	17.32	7 " 6 "	330.5
20	259	45	19.49	8 "	376.0
25	267	50	21.65	8 " 6 "	424.5
30	274	55	23.82	9 "	475.9
35	281	60	25.99	9 " 6 "	530.2
40	286	65	28.15	10 "	587.5
45	292	70	30.32	11 "	710.9
50	298	75	32.48	12 "	846.0
55	303	80	34.65	13 "	992.0
60	307	85	36.82	14 "	1151.5
65	312	90	38.98	15 "	1321.9
70	316	95	41.15	20 "	2350.1
75	320	100	43.31	25 "	3670.0
80	324	115	49.50	30 "	5287.7
85	328	130	55.90	35 "	7197.1
90	331	150	64.50	40 "	9400.3
95	334	175	75.25		
100	338	200	86.15		

MEMORANDA

MEMORANDA

USEFUL INFORMATION.

STEAM.

A CUBIC inch of water evaporated under ordinary atmospheric pressure is converted into 1 cubic *foot* of steam (approximately).

The specific gravity of steam (at atmospheric pressure) is .411 that of air at 34° Fahrenheit, and .0006 that of water at same temperature.

27,222 cubic feet of steam weigh 1 pound; 13,817 cubic feet of air weigh 1 pound.

Locomotives average a consumption of 3,000 gallons of water per 100 miles run.

The best designed boilers, well set, with good draft and skilful firing, will evaporate from 7 to 10 lbs. of water per pound of first-class coal.

In calculating horse-power of Tubular or Flue boilers, consider 15 square feet of heating surface equivalent to one *nominal* horse-power.

On one square foot of grate can be burned on an average from 10 to 12 lbs. of hard coal, or 18 to 20 lbs. of soft coal, per hour, with natural draft. With forced draft nearly double these amounts can be burned.

Steam Engines, in economy, vary from 14 to 60 lbs. of feed water and from 1½ to 7 lbs. of coal per hour per indicated H. P. See table below for duty of high grade engines.

Condensing engines require from 20 to 30 gallons of water, at an average low temperature to condense the steam represented by every gallon of water evaporated in the boilers' supplying engines—approximately for most engines, we say, from 1 to 1½ gallons condensing water per minute per indicated horse-power.

Surface Condensers should have about 2 square feet of tube (cooling) surface per horse-power for a compound steam engine. Ordinary engines will require more surface according to their economy in the use of steam. It is absolutely necessary to place air pumps below condensers to get satisfactory results.

RATIO OF VACUUM TO TEMPERATURE (FAHRENHEIT) OF FEED WATER.

00 inches, Vacuum	......212°	22½ inches, Vacuum	......150°	28½ inches, Vacuum	......92°
11 ,, ,,	......190°	*25 ,, ,,	......135°	29 ,, ,,	......72°
18 ,, ,,	......170°	27½ ,, ,,	......112°	29½ ,, ,,	......52°

*Usually considered the standard point of efficiency—Condenser and Air Pump being well proportioned.

WEIGHT AND COMPARATIVE FUEL VALUE OF WOOD.

1 Cord Air-dried	Hickory or Hard Maple weighs about 4,500 lbs., and is equal to about 2,000 lbs. coal.
1 ,, ,,	White Oak weighs about 3,850 lbs., and is equal to about 1,715 lbs. coal.
1 ,, ,,	Beech, Red Oak, and Black Oak weighs about 3,250 lbs., and is equal to about 1,450 lbs. coal.
1 ,, ,,	Poplar (whitewood), Chestnut, and Elm weighs about 2,350 lbs., and is equal to about 1,050 lbs. coal.
1 ,, ,,	Average Pine weighs about 2,000 lbs., and is equal to about 925 lbs. coal.

From the above it is safe to assume that 2¼ lbs. of dry wood is equal to 1 lb. average quality of soft coal, and that the full value of the same *weight* of different woods is very nearly the same—that is, a pound of hickory is worth no more for fuel than a pound of pine, assuming both to be dry. It is important that the wood be dry, as each 10 per cent. of water or moisture in wood will detract about 12 per cent. from its value as fuel.

DUTY OF STEAM ENGINES.

A well-known engineer of high authority gives the following comparative figures showing the economy of high grade steam engines in actual practice:

Type of Engine.	Temperature of Feed Water.	Lbs. of Water Evaporated per lb. of Cumberland Coal.	Pounds of Steam per 1 H. P. used per hour.	Pounds of Cumberland Coal used per 1 H. P. per hour.	Cost per 1 H.P. per hour, supposing Coal at $6.00 per ton.
Non-Condensing............	210°	10.5	29.	2.75	$0.0073
Condensing	100°	9.4	20.	2.12	0.0056
Compound Jacketed........	100°	9.4	17.	1.81	0.0045
Triple Expansion Jacketed.	100°	9.4	13.6	1.44	0.0030

⁂ The effect of a good condenser and air pump should be to make available about 10 lbs. more mean effective pressure than the same terminal pressure; or to give the same mean effective pressure with a correspondingly less terminal pressure. When the load on the engine requires 20 lbs. M. E. P., the condenser does half the work; at 30 lbs., one third of the work; at 40 lbs., one fourth, and so on. It is safe to assume that practically the condenser will save from one fourth to one third of the fuel, and it can be applied to any engine cut-off, or throttling, where a sufficient supply of water is available.

THE ABOVE IS FROM WALWORTH MFG. CO.'S POCKET PRICE-LIST BY PERMISSION.

WATER.

DOUBLING the diameter of a pipe increases its capacity four times. Friction of liquids in pipes increases as the square of the velocity.

The mean pressure of the atmosphere is usually estimated at 14.7 lbs. per square inch, so that with a perfect vacuum it will sustain a column of mercury 29.9 inches or a column of water 33.9 feet high at sea level.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434. Approximately, we say that every foot elevation is equal to ½ lb. pressure per square inch; this allows for ordinary friction.

To find the diameter of a pump cylinder to move a given quantity of water per minute (100 feet of piston being the standard of speed), divide the number of gallons by 4, then extract the square root, and the product will be the diameter in inches of the pump cylinder.

To find quantity of water elevated in one minute running at 100 feet of piston speed per minute, square the diameter of the water cylinder in inches and multiply by 4. Example: Capacity of a 5 inch cylinder is desired. The square of the diameter (5 inches) is 25, which, multiplied by 4, gives 100, the number of gallons per minute (approximately).

To find the horse power necessary to elevate water to a given height, multiply the weight of the water elevated per minute in pounds by the height in feet, and divide the product by 33,000 (an allowance should be added by water friction, and a further allowance for loss in steam cylinder, say from 20 to 30 per cent).

The area of the Steam Piston multiplied by the steam pressure gives the total amount of pressure that can be exerted. *The area of the water piston* multiplied by the pressure of water per square inch gives the resistance. *A margin* must be made between the *power* and the *resistance* to *move* the pistons at the required speed — say from 20 to 40 per cent., according to speed and other conditions.

To find the capacity of a cylinder in gallons. Multiplying the area in inches by the length of stroke in inches will give the total number of cubic inches; divide this amount by 231 (which is the cubical contents of a U. S. gallon in inches) and the product is the capacity in gallons.

WEIGHT AND CAPACITY OF DIFFERENT STANDARD GALLONS OF WATER.

	Cubic Inches in a Gallon.	Weight of a Gallon in pounds.	Gallons in a Cubic Foot.	
Imperial or English	277.274	10.00	6.232102	Weight of a cubic foot of water, English standard, 62.321 lbs. Avordupois.
United States..............	231.	8.33111	7.480519	

Weight of Crude Petroleum, 6½ lbs. per U. S. gallon, } 42 gallons to the barrel.
Weight of Refined ,, 6½ lbs. per U. S. gallon, }

A "miner's inch" of water is approximately equal to a supply of 12 U. S. gallons per minute.

FIRE STREAMS.

Pressures required at nozzle and at pump, with quantity and pressure of water necessary to throw water various distances through different sized nozzles — using 2½ inch rubber hose and smooth nozzles.

G. A. Ellis, C. E.

Size of Nozzles.	1 Inch.				1⅛ Inch.				1¼ Inch.				1⅜ Inch.			
Pressure at nozzle......	40	60	80	100	40	60	80	100	40	60	80	100	40	60	80	100
*Pressure at Pump or Hydrant with 100 ft. 2½ inch rubber hose.	48	73	97	121	54	81	108	135	61	92	123	154	71	107	144	180
Gallons per minute....	155	189	219	245	196	240	277	310	242	297	342	383	293	358	413	462
Horizontal dist. thrown	109	142	168	186	113	148	175	193	118	156	186	207	124	166	200	224
Vertical dist. thrown...	79	108	131	148	81	112	137	157	82	115	142	164	85	118	146	169

*For greater lengths of 2½ hose the increased friction can readily be obtained by noting the differences between the above given "pressure at nozzle" and "pressure at pump or hydrant with 100 *feet* of hose." For instance, if it requires at hydrant or pump 8 lbs. more pressure than it does at nozzle to overcome the friction when pumping through 100 feet of 2½ inch hose (using 1 inch nozzle, with 40 lb. pressure at said nozzle), then it requires 16 lbs. pressure to overcome the friction in forcing through 200 feet of same size hose.

THE ABOVE IS FROM WALWORTH MFG. CO.'S POCKET PRICE-LIST BY PERMISSION.

L. of C.

Water occupies the least space when at 39° Fht.

Water expands about one-tenth of its bulk in freezing.

Water expands about one-twenty-fifth of its bulk when heated from 40° to 200° Fht.

Ice weighs 56⅓ lbs. per cubic foot.

The U. S. Standard gallon measures 231 cubic inches and contains 8⅓ lbs. distilled water.

A cubic foot of water weighs 62½ lbs. (salt water 64.3 lbs.) and contains 1,728 cubic inches, or nearly 7½ gallons U. S. Standard.

To evaporate one cubic foot of water requires the consumption of 7½ lbs. of ordinary coal; or about one lb. of coal to one gallon of water.

United States gallons multiplied by .133367 equals cubic feet.

A barrel contains 7,689 cubic inches.

Gallons per second x 474.08 = cubic feet per hour.

Gallons per minute x 7.9 = cubic feet per hour.

One cubic foot of anthracite coal weighs about 53 lbs.

One cubic foot of bituminous coal weighs about 47 to 50 lbs.

One ton of coal is equivalent to two cords of wood for steam purposes.

One ton of anthracite coal occupies about 36 cubic feet of space.

One ton of bituminous coal occupies about 41 cubic feet of space.

Cast iron weighs 450 lbs. per cubic foot, and castings of crucible steel about the same.

Wrought iron weighs 486.6 pounds per cubic foot.

A plate of wrought iron one foot square, one inch thick, may be reckoned at 40 pounds, but 40.55 pounds is more exact.

A cubic inch of cast iron weighs .26; tin, .246; wrought iron, .281; brass, .311: copper, .321 and lead, .411 pounds.

To find circumference of a circle multiply diameter by 3.1416.

To find diameter of a circle multiply circumference by .31831.

To find area of a circle multiply square of diameter by .7854.

To find area of a triangle multiply base by one-half of the perpendicular line.

To find surface of a ball multiply square of diameter by 3.1416.

To find solidity of a sphere multiply cube of diameter by .5236.

To find side of an equal square multiply diameter by .8862.

To find cubic inches in a ball multiply cube of diameter by .5236.

The hypothenuse of a right angle triangle is equal to the square root of the sum of the squares of the two sides.

There are many different boiler compounds prepared and sold by various makers, nearly all of which are effective in certain kinds of water. Among the best is one composed of:

Sal Soda	40 lbs.
Catichu	5 "
Sal Ammoniac	5 "

One of the best varnishes for smoke-stacks or steam-pipes is good asphaltum dissolved in oil of turpentine.

Oxalic acid dissolved in soft water, say ½ an ounce to a pint, is one of the best known means for cleaning and brightening brass work.

Iron or steel, immersed warm in a solution of carbonate of soda (washing soda) for a few minutes, will not rust.

A solvent for Rust.—It is often very difficult and sometimes impossible to remove rust from articles made of iron. Those which are most thickly coated, are most easily cleaned by being immersed in a solution, nearly saturated, of chloride of tin. The length of time they remain in this bath is determined by the thickness of the coating of rust. Generally twelve to twenty-four hours is long enough. The solution ought not to contain a great excess of acid, if the iron itself be not attacked. On taking them from the bath, the articles are rinsed, first in water, then in ammonia, and quickly dried. The iron, when thus treated, has the appearance of dull silver. A simple polishing gives it its normal appearance.

To remove Rust from Steal.—Brush the rusted steel with a paste composed of ½ oz. cyanide potassium, ½ oz. castile soap, 1 oz. whiting, and enough water to make a paste. Then wash the steel in a solution of ⅛ oz. cyanide of potassium in 2 ozs. of water.

Rust Joint.—(For quick setting.) Sal ammoniac powdered, 1 lb; flour of sulphur, 2 lbs; iron borings, 80 lbs; mix to a paste with water. (Slow setting.) Sal ammoniac, 2 lbs; sulphur, 1 lb; iron borings, 200 lbs. The latter is best if the joint is not needed for use at once.

To Brighten Tarnished Brass and Copper.—Clean the brass by warming it, and dipping in water charged with washing soda, then into clean water to remove the grease. Next dip it in a bath of one part, by measure, of sulphuric acid, one part sal ammoniac, two parts nitric acid, and four parts water. Dip for a moment, then dip into clear water, and dry in hot sawdust. Oxalic acid dissolved in soft water, say ½ ounce to a pint, is one of the best known means for cleaning and brightening brass work.

To Cut a Glass-gauge Tube.—If a glass-gauge tube is too long, take a three-cornered file and wet it; hold the tube in the left hand with the thumb and fore-finger at the place where you wish to cut; saw it quickly and lightly two or three times with the edge of the file and it will mark the glass. Now take the tube in both hands, both thumbs being on the opposite side to the mark, and about an inch apart, then try to bend the glass using your thumbs as fulcrums, and it will break at the mark which has weakened the tube.

To Keep Machinery from Rusting.—Take one ounce of camphor, dissolve it in one pound of melted lard; take off the scum and mix in as much fine black lead as will give it iron color. Clean the machinery and smear it with this mixture. After twenty-four hours rub with a soft linen cloth until clean. It will keep clean for months under ordinary circumstances.

To Clean Brass (U. S. Government Method.)—Make a mixture of one part common nitric acid and one-half part sulphuric acid in a stone jar, having also a pail of fresh water and a box of sawdust. Dip the articles into the acid, and then soak them in the water and finally rub them in the sawdust and they will take on a brilliant color. If the brass is greasy, it must be first dipped into a strong solution of potash and soda in water, and then rinsed, so that the grease may be removed leaving the acid free to act.

To find the diameter of a pump cylinder to move a given quantity of water per minute, divide the number of gallons by 4, then extract the square root, and the product will be the diameter in inches of a pump cylinder required to do the work at a piston travel of 100 ft. per minute.

When you have to repair your boiler furnace and can't get any fire clay, take common earth mixed with water in which you have dissolved a little salt; use same as fire clay.

How to Write Inscriptions on Metals.—Take 4 ozs. of nitric acid and 1 oz. of muriatic acid, mix and shake well together, and it is ready for use. Then cover your metal surface to be engraved with beeswax or soap, write your inscription plainly in the wax clear to the metal, then apply the mixed acids with a feather or a stick of wood, carefully filling each letter, let it remain from five to ten minutes, according to appearance desired, then throw on water, which stops the etching process, and the inscription is completed.

Cement to Fasten Iron to Stone.—Take 10 parts of fine iron filings, 30 parts of plaster of paris, and ½ part of sal ammoniac; mix with weak vinegar to a fluid paste and apply at once.

Advertisements

THE reputation of those whose advertisemements appear on the following pages is too well established to need comment, therefore I commend them to your confidence.

It will be a kindness to them, as well as myself, if when writing them you will make known the fact of having seen their business card in this book.

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RELIABILITY
DURABILITY
QUALITY

LARGEST STOCK of air-seasoned, strictly clear Cypress. Bright, as well as stained sap all cut out.

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Enable us to give the COMMERCIAL GROWER better material, workmanship, and service than any other manufacturer.

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IN GREENHOUSES

L. O. KOVEN & BROTHER'S
ANTI-WASTE EXPANSION TANKS

should always be used. Expansion Tanks, Galvanized Iron Range Boilers, Filters, Water Tanks, Riveted Pipe, Mixing Tanks, Smoke-stacks and Sheet Iron Work of Every Description *

L. O. KOVEN & BROTHER

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For Twenty Years

The "MINNEAPOLIS"

Heat Regulator has been PROFITABLE to DEALER and CONSUMER,—suitable for hot water, hot air, steam or combination heat, street steam, and natural gas. Installed at any time,—automatic, operates on a change of 1°. Thermostat changed from one temperature point to another instantly. Thousands in use in Greenhouses. Satisfaction guaranteed,—sold subject to approval. Price and illustrated booklet upon application.

Electric Heat Regulator Company

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GAS STEAM AND HOT WATER FITTERS REVIEW

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